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ABSTRACT

Focusing on ways in which Oregon educators have made use of computers, the 47 papers in this proceedings show substantial progress in some areas and point out some unanswered research, instructional, learning, and management questions. The contents are divided into three general areas: Curriculum Applications, Learning and Teaching, and Classroom and School Management. Each major section is further sub-divided into topic areas which contain from one to four papers each: (1) Elementary Education; (2) Language Arts; (3) Mathematics; (4) Science; (5) Social Studies; (6) Business; (7) Art; (8) Music; (9) Health; (10) Programming; (11) Instructional Design; (12) Problem Solving; (13) Special Education; (14) Computer Networking; (15) Library and Information Systems; (16) Classroom Management; (17) Legal Implications; (18) Computer Coordination; (19) Hardware/Software Purchasing; and (20) Computer Support of School Management. An author index is provided. (JB)

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4TH ANNUAL "EXTENDING THE HUMAN MIND: COMPUTERS IN EDUCATION" SUMMER CONFERENCE

PROCEEDINGS - '85

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PROCEEDINGS

EXTENDING THE HUMAN MIND: COMPUTERS IN EDUCATION

Fourth Annual Summer Computer Conference
Sponsored by
Center for Advanced Technology in Education
and
Continuation Center
University of Oregon

Held at the
Eugene Conference Center
Eugene, Oregon
August 19-21, 1985

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PREFACE

This is the Fourth Summer Conference in this series sponsored by the University of Oregon. Understanding and using wisely the advanced technology now becoming available to us is a challenge worthy of any educator. We at the University of Oregon are pleased to contribute to that understanding and appropriate use.

The Conference is sponsored this year by the Center for Advanced Technology in Education, recently established by the Oregon State Board of Higher Education, and by the University of Oregon Continuation Center.

Primary roles in the organization of this Conference were played by Paul Katz, Conference Manager, and Bruce McKinlay, Program Chair.

The Program Committee also consisted of Gary Farrington, David Moursund, Jack Turner and Sam Miller.

Robert D. Gilberts, Dean
College of Education

About CATE and the Continuation Center

The Center for Advanced Technology in Education (CATE) is a consortium of university-based, community and state organizations with an interest in the use of advanced technology in schools. The educational use of computers is a primary focus of the Center's activities.

Opened in the fall of 1983, CATE is the site of both preservice and inservice training for educators and a field-based research and development program investigating a variety of advanced and interactive instructional technologies and their implications.

Members of the CATE Council and the CATE network are widely scattered across Oregon. They include school districts, state colleges, community colleges, extension services and the State Department of Education. Housed in the CATE facility at 1787 Agate is the ERIC (Educational Resources Information Center) Clearinghouse on Educational Management, the International Council for Computers in Education (ICCE), the Instructional Technology (IT) Laboratories, and the Career Information System (CIS). There are also a resource library and facilities for classes and workshops on the use of computers in education.

Leadership in fulfilling the University's outreach responsibilities rests with the University of Oregon Continuation Center, composed of the Community Education Program, Summer Session and Continuing Education. A primary goal of the Continuation Center is to promote educational programs which link research and knowledge in the University with interests and questions in the community. The programs, which include courses, workshops, specialized resources and conferences, must be contemporary and significant. Programs are provided at all levels, serving preschoolers to senior researchers, community professionals and non-professionals. The Continuation Center is concerned with broad-based, pervasive educational issues of our time. Few topics fit this concern so clearly as the Annual Summer Conference "Extending the Human Mind: Computers in Education."

For more information about CATE or the Continuation Center, write to Center for Advanced Technology in Education, 1787 Agate, Eugene, Oregon 97403, or the Continuation Center, 333 Oregon Hall, University of Oregon, Eugene, Oregon 97403.

About The Proceedings

The sponsors of the Fourth Annual Summer Conference "Extending the Human Mind: Computers in Education," the Center for Advanced Technology in Education (CATE) and the Continuation Center, are pleased to offer these proceedings.

Appreciation is due the Conference presenters for their promptness in meeting deadlines so that the proceedings could become a reality. The papers are grouped under the Conference's three organizational themes. To meet publication deadlines and control printing costs, the papers are presented exactly as they were received.

The authors of these papers were invited to make presentations at this Conference because of their acknowledged scholarly or professional competence in some aspect of computers and education. The findings, views or opinions expressed by those authors, however, are entirely their own and do not necessarily represent those of CATE, the Continuation Center or the University of Oregon.

Additional copies of the proceedings may be obtained by sending $20.00 (prepaid or purchase order) to Proceedings, Center for Advanced Technology in Education, 1787 Agate Street, University of Oregon, Eugene, Oregon 97403. Checks should be made payable to CATE.

FOREWORD

The discussion of computers in education is maturing. Educators are spending less time asking "What are they?" and "How do they work?" and they are now asking "How can they serve education?"

This year's conference reflects that shift by focusing on applied uses of the computer in education. More than any of the three preceding conferences in this series, this year's conference has practitioners talking about what they have done with computers.

The papers in these Proceedings are organized into three general areas. The first section covers Curriculum Applications in the classroom. Judy Edwards Allen's paper provides a useful context by countering five common presumptions about computers for instruction. The other papers in this section discuss computer uses in a variety of basic academic curricula.

The use of the computer as a learning tool has highlighted some fundamental and longstanding questions of how people learn and how schools can teach. Dexter Fletcher opens the section on Learning and Teaching with a perceptive discussion of what we know and what we need to learn about the role of the computer in the learning process. The special topic papers cover a variety of technological and learning topics, ranging from local area networks to brain research.

The computer's most successful applications have been in personal productivity such as word processing and in organizational productivity such as accounting. Schools have no less need than businesses for efficient resource management, so the third theme in this volume is Classroom and School Management. Stanley Pogrow provides an overview of the state of the art in administrative computing. His paper is followed by explanations of a variety of school and school district management issues and tools.

In reading these papers, one has to be impressed with the variety of ways in which educators have been applying the computer. The papers show substantial progress in some areas, and also point out unanswered research, instructional, learning and management questions. By providing a forum for describing and reviewing the uses of computers in education, the conference and these proceedings can help all of us to monitor progress in the field. Such a sampling provides overviews of a new and dynamic field, and avoids the narrow specialization that has led education down many blind alleys in the past.

Bruce McKinlay
Program Chair
"Extending the Human Mind: Computers in Education" 1985

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FIVE MYTHS ABOUT COMPUTERS IN THE CURRICULUM

by Judy Edwards Allen

Writing this paper has been a long process. I made up the title in February when I was asked to do this, feeling sure at that time that I could come up with at LEAST five myths. My problem since then has been one of weeding out, of trying to select ONLY five myths. I think there may be more like twelve. Or maybe seventeen.

It must be the height of arrogance to announce to you that there are even five myths about computers in the curriculum. I have always laughed at the willingness of the so-called experts in computer education to pronounce truths, particularly if I did not agree with that person's "truth."

So I give you permission to reject what I believe to be true in favor of your own truth. I intend not that this be a monologue, but a polylogue, if that is a word. I invite discussion. What myths have YOU encountered?

The Myths

Here are my five finalists for Most Mythical:

1. Kids Need to Become Computer Literate
   ...and teaching programming will do that
   ...and teaching programming will make kids better problem solvers to boot

2. Teachers are Afraid of the Computer
   ...and teaching programming will make teachers more computer literate, therefore less afraid

3. Computers Desocialize and Isolate Children

4. Ninety-Five Percent of the Available Software is Trash
   ...and(/because?) drill has no value in the curriculum

5. Computers, Math and Science Should Be the Top Priority Subjects in the Curriculum

One: Kids Need to Become Computer Literate

My first response to that argument would be to laugh --better we should try to stop the tide from coming in than keep kids from becoming computer literate. Kids will become computer literate, whether or not we impose it on them. Our efforts should be aimed at providing software and hardware in an accessible place for kids who will never have such access at home. And to assure that minorities, the poor, and girls are given equal access. It does not happen just by wishing it were so, or by encouraging those groups to use the computer. It takes careful planning and scheduling, and vigilant monitoring.

But is computer literacy what kids will need? Children who are entering school now will spend their entire working life in the 21st century. Will computer literacy be important in a world where computers are ubiquitous and nearly invisible? In a world where computers can and do program themselves more efficiently than humans? In a world where artificial intelligence, we are told, can decide when to push The Button?

The electronic office is already a reality. When my two-year old grandchild arrives in 2005 for her first day on the job, her desk will have the ever-present telephone AND a portable computer the size of a notebook, with several million characters of storage, a non-volatile memory, built-in word processors, spreadsheets, file managers, databases, and telecommunications link. It may not look like a computer as we know it now. For that matter, the telephone may not look like a telephone. It may look like the computer. In fact, it may BE the computer. The desk information center, if we may call the hybrid telephone/computer that, will be her link to her coworkers, to inhouse company databases, to local, regional, national and international databases. She will communicate through it, retrieve information through it, organize and process information with it, organize her thoughts with it. She can move her office to her living room by putting the device in her briefcase.

Does my grandchild need to be "computer literate?" She may not even need keyboarding skills, if voice entry is commonplace by then, and it should be. She will need to be TECHNOLOGICALLY LITERATE, or perhaps INFORMATION LITERATE. She will need to know how to find information, where to find information, how to organize and interpret it, and how to use it to solve problems. These skills will be in HER brain, and she will use the equipment on her desk to fetch and tote and scribble. She will need to be able to intelligently address ethical headaches about the use of information. And, as a citizen of a world society, she will need to participate in decision-making about issues we are only now hazily beginning to recognize.

The ethical and moral side effects of a heart transplant or an artificial heart are difficult to talk about, difficult for us to reach consensus about. How then will we face the 21st century challenges of brain transplants and artificial brains? More important, how will we create a curriculum that will prepare our children and grandchildren to tackle ethical and moral issues related to biotechnology?

Teaching programming to achieve computer literacy may be, arguably, necessary in the short term. There are more important kinds of literacy we should be talking about for the long term.

Teaching programming to achieve computer literacy has created a generation of "hackers" who are programming geniuses with only the faint beginnings of a value system that will effectively govern the choices they make about what to do with their skills. And those skills may be unimportant in future job markets.

Finally, programming is touted by my friends in computer education as a sure-fire way to "improve problem-solving skills." Problem solving is a problem, granted. Problem solving is listed by the Oregon Department of Education as a basic skill. How are we going to teach it? The Department of Education doesn't tell us that. If programming will do it, why not teach programming?

Here's why not. It won't improve the IMPORTANT problem solving skills. If it could, as Joe Weizenbaum has pointed out, computer scientists would be better than any of the rest of us at solving life's problems. They aren't.

When I ask my colleagues what they mean by problem solving, it turns out they mean logical, linear, analytic problem solving. Although I have yet to see hard data to convince me that programming improves even that kind of problem solving, it does seem, intuitively, that it should. Of course, logical, linear, analytic problem solving skill is important for solving logical, linear problems. It won't help my child deal with her friends, her enemies, her teachers, her parents, her coworkers, her boss, her children, her husband or the IRS. In fact, using logical analysis in a problem with her husband is likely to escalate the problem.

This argument causes my colleagues to switch words. They start to talk about "higher level thinking skills." Programming will improve "higher level thinking skills." Now, what is that? We could use Bloom's taxonomy and look at the highest levels, and we find that we're talking about analysis, synthesis, and, at the top, evaluation. I would like to be convinced that learning to program would help us with anything beyond "analysis." I'm willing to be convinced because, again intuitively, it does seem that tackling a difficult programming problem could require synthesis and perhaps evaluation.

Two: Teachers Are Afraid of the Computer

In my observation, this is hardly ever the case. Teachers do not "fear" the computer. Teachers are busy. They know, and they are correct in this, that if they choose to become computer-using educators they will have to spend TIME before they will be comfortable with computers. And the need to spend time will continue. They have seen what happens to their computer-using colleagues. Teachers are busy, and they are tired. The suggestion that they should learn a (probably complicated) new skill on their limited "free" time, and put forth the effort to find resources, find quality software, keep up with new developments, and integrate computer applications into an already-full curriculum -- this suggestion makes them feel very tired indeed. Teachers are busy, they are tired, and they have been led down the garden path of learning programming to achieve computer literacy.

Here are two stories, not isolated cases and not unique.

Recently I was invited to attend a faculty meeting at an elementary school which was going to become a primary school next year. The topic under discussion was "what will become of the 15 computers when we lose our 6th grade and our computer resource teacher?"

Several proposals were put forth. One was to keep all the computers in the computer resource room and have teachers bring their classes in to use them. Another was to put a computer in every classroom. Another was to hire a half-time aide to replace the full-time computer resource teacher. The last proposal was vetoed due to lack of funds. That left two alternatives: teachers bring their classes to the computer room, or each teacher has a single computer in her classroom.

I looked around the room, and on every teacher's face I saw the same expression. Distate mingled with horror at the options being proposed.

"I wouldn't know what to do with it if I had one in my room."

"I wouldn't know what to do if I took my class to the computer room."

"I'm not comfortable with computers. I would have to rely on a resource teacher if I had to use them."

At this point I made the observation that perhaps some inservice training would help the teachers to feel more comfortable with using computers in their teaching.

The curriculum director was swift and sure in her reply: "These teachers have had the best inservice training you can get anywhere. Every single one of them has had the district computer literacy course. They don't need further inservice."

The "district inservice course" in question was an excellent, thorough, and exemplary course in BASIC programming.

The teachers registered disbelief. These teachers had indeed learned to program in BASIC, yet not one was willing to suggest that she felt comfortable enough with the computer to use it in her teaching.

Story number two: A student in one of my classes recently came up to me after class to tell me that he wished his wife, an elementary teacher, had taken my class instead of the district computer literacy class. (Different district, different class.) She had learned to program in BASIC, learned all there is to know about frustration, and learned to view the computer with a great deal of hostility. She had no intention of programming her own courseware, and could see no further use for the computer in the classroom.

I tell these stories not to prove a point, but to illustrate what can happen if programming is seen as the NECESSARY and SUFFICIENT route to computer literacy.

And I would like to propose we use a different term when talking about a goal for computer-using teachers: they should acquire "computer comfort." That may be the same as computer literacy, or more than computer literacy, or less than computer literacy. I don't care. But I suggest that without computer comfort, a teacher WILL NOT use the computer in the classroom, regardless of how "literate" he or she may be. And fear has nothing to do with it. Loathing, maybe.

Three: Computers Desocialize and Isolate Children

Some worriers have pictured a future of electronic "learning stations" in schools, one child to each computer, with the teacher in the background or not present. Hackers have created an image of the asocial technonerd, out of touch with his peers and unable to communicate with human beings.

This scenario is unlikely to materialize. The cost of supplying schools with one computer per child would be in the neighborhood of the national deficit. Instead, schools will likely continue to make computers available for sharing --two or three children per computer, except in word processing labs. Experience has shown that such use leads not to desocialization but to its opposite. Children discuss their computer projects, make collaborative decisions about how to respond to the computer, and plan strategies together. They teach each other. It is impossible for most teachers to "stay ahead of the students," so students begin to share their knowledge and skills with each other. Wise teachers designate students as peer tutors to help others learn computer skills. These teachers share authority, and abdicate the need to be the "answer person."

John Naisbitt, in his book Megatrends, has developed a charming notion called "High Tech/High Touch." He observes that the more technology increases, the more we as a society need a "high touch" alternative. As we become more reliant on word processors, we write more personal notes and letters. He points out that the more high technology we introduce into society the more people will aggregate, will want to be with each other. Shopping malls, for example, are now the third most frequented place in our lives, after home and workplace. What could be more high tech/high touch than 70,000 people crowding into a huge stadium to participate in a rock concert beamed round the world by 12 satellites?

I have observed a phenomenon in my own use of computers that I understand better after reading Megatrends. My husband built a beautiful desk for my study at home, customized for my Apple IIe and printers. And yet I find myself continually dismantling all the pieces and lugging the computer, two disk drives, monitor, and two printers into the common room where family activity takes place. I set it all up on a card table in the middle of everything, and happily do my work. My beautiful desk sits empty in an empty room. High tech/high touch.

More recently I have abandoned my Apple for a computer which has become a part of me. My husband bought a HP 110 portable computer, battery operated, with disk drive and printer. All of them fit in a "luggable" case the size of a portable sewing machine. The computer alone fits in a notebook-sized carrying case. We may have to buy a second one. I find that I can take it out to the hammock and write, sit up in bed and write, meet a deadline while eating French toast in a cafe and dribbling syrup on the keyboard, take it to meetings and classes for note-taking, and I spent a pleasant afternoon on the beach drafting a book chapter, until a small boy settled in nearby for some enthusiastic sand-flinging.

The HP 110 and others like it are just today's expensive versions of the lap computer we will all have in a year or two. Kids who study in flocks close to the stereo will study with their friends and their lap computers under a tree, as George Leonard predicted 15 years ago in Education and Ecstasy. Lap computers may replace personal earphones, certainly a more socializing trend. As computers become more and more personal, they can more easily be incorporated into social surroundings. High tech/high touch. In fact, socializing is beginning to be a product of technology, as students begin to "network" and communicate by electronic mail with students in schools in other parts of the country.

Four: Ninety-Five Percent of the Available Software is Trash

This kind of statement has made headlines for more than one educational computer specialist. Fortunately, it is no longer true. A totally subjective look at available software could lead one to believe that "ninety-five percent is trash" or that on the whole there are many excellent software packages available for classroom use. The several validated software evaluation organizations have published hundreds of positive software evaluations, indicating that the overall quality is improving. More attention is being given to pedagogical content and presentation and there is less preoccupation with the "bells and whistles" of the early microcomputer days.

While few software packages are perfect, most are very usable in their present format, and can contribute to achievement of a teacher's instructional intent. No single software application can be universally acceptable to all teachers. What I may find to be brilliant you may call trash, and vice versa. My teaching needs may require software to use a guided approach to discovering important relationships, and your teaching needs may require software to deliver 20 minutes per day per child of arithmetic or grammar drill and practice.

There need be no value judgment about the generic "quality" of drill and practice vs. learner-controlled simulations. The learner outcome desired should determine the type of software selected. If the learner outcome is a low level rule or fact, drill may be the most appropriate, efficient, and effective method of reinforcing learning. On the other hand, if higher level thinking skills such as analysis, synthesis, and evaluation are desired, interaction with a complex model on the computer would certainly be more appropriate.

Five: Computers, Math and Science Should Be Top Curriculum Priorities

Amid the general euphoria about the promise of the computer in the curriculum, there are quieter, more skeptical voices. Derek Bok, president of Harvard University, points out in his annual report:

> "Many important tasks remain beyond the reach of the new technology. With all its powers, the computer cannot contribute much to the learning of open-ended subjects like moral philosophy, religion, historical interpretation, literary criticism, or social theory -- fields of knowledge that cannot be reduced to formal rules and procedures. Since such subjects are among the most important in the curriculum, this limitation is hardly trivial. Computers are also incapable of inspiring students or serving as role models. They cannot conduct a genuine dialog, because they cannot comprehend analogies or metaphors or even understand conversation beyond the five-year-old level. Finally, machines can rarely tell why a student is experiencing difficulty in learning and understanding."

The possibility certainly exists that computers will one day be able to conduct a genuine dialogue, through research being conducted now in artificial intelligence. (Will that dialogue be as "good" as a dialogue with a human being?) And the research in the new discipline of cognitive science foretells a time when computers will be able to diagnose "bugs" in student learning and understanding.

Meanwhile, however, the current emphasis on math, science, and computers in the curriculum reminds us of the scramble to "catch up with the Russians" in the late 50's, and the national furor of emphasis on the physical sciences, often at the expense of the softer sciences, the arts, the humanities. Those subjects that tend to be qualitative, ambiguous, speculative, and not reducible to formal rules and algorithms may in fact be more important at a time when other cultures and nations are not willing to "play by the rules" --particularly if those rules are American-made.

Even in these subjects, though, the computer can be used to engage students in more active exploration, discovery, and thinking about important issues.

The problems of the 21st century are likely to require solutions that are beyond the purview of science alone. In fact, many of the most thorny problems are likely to be those which are caused, at least in part, by scientific and technological progress.

In Megatrends, Naisbitt makes the observation that societies, like individuals, can handle only so many concerns at one time. Concern with civil rights was erased when concern with the environment intruded. Concern with racism gave way to concern with sexism, and both yielded to concerns about ageism. Naisbitt calls it "forced choice in a closed system." He suggests that societies and individuals add new preoccupations and forget old ones on a regular basis, able to keep only so many problems and concerns in their heads or hearts at any one time.

If the resurgent "preoccupation" in education is computers, math, and science, will be be able to continue to care about other ways of looking at our world?

Beyond Myths

Beverly Hunter, in a paper discussing fundamental curriculum content, made an important observation. She contends that individual teachers, schools, and districts all apparently go through three overlapping stages in the evolution of curriculum change.

In stage one, technology -- especially computers -- are the object of study. New courses, primarily in computer programming or "computer literacy" are established.

In stage two, technology, especially computers, are viewed as tools which can support the curriculum in a variety of subject areas. Curriculum work is aimed toward integrating the use of the tools into the existing curriculum in math, science, social studies and language arts.

In stage three, the focus is less on technology and more on reassessment of curriculum goals and priorities, especially with regard to the relative emphasis on problem solving, information handling, algorithmic thinking, creative communications, and so forth.

Clearly, most schools, districts, and individuals are still in stage one, which is a necessary stage. In fact, learning ABOUT technology is a necessary prerequisite to USING the technology to enhance and support classroom learning. Electronic Learning magazine reported in April 1984 that 83 percent of schools they surveyed offer introductory courses in computer literacy.

It may be that the "five myths" I have talked about are only relevant as long as we remain in stage one of curriculum change. Computer literacy and programming are clearly stage one activities. Teachers who have been made hostile by programming courses may be rescued by a course in curriculum applications of the computer (if they can be convinced to give it another chance). Integration of technology into the curriculum prevents the isolation that could occur if computers were placed in a separate study carrel and used as the object of study. As our use of computers to support learning increases, software publishers respond to the demand and produce the kind of packages we are asking for. Curriculum priorities may continue to be math, science, and computers, but the computer may begin to be the tool of math and science rather than the focus of study.

And soon, if Beverly Hunter is correct, we will see schools beginning to reassess the entire curriculum to determine what changes should be made BECAUSE OF technology. That is already happening in the language arts, as writing teachers examine the writing process and restructure their teaching around the use of the word processor to creatively support that process.

Let me end with a challenge. As you attend conferences, read computer magazines, and listen to your colleagues, what myths are you hearing, and perhaps perpetuating? Do you believe what you are hearing? Does your own experience tell you something else? And finally, what alternatives do you see?

What IS the place of the computer in the curriculum? Let's talk.

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COMPUTERS IN ELEMENTARY EDUCATION: EUGENE DISTRICT 4J

(WORKS IN PROGRESS)
by
Jack Turner, Computer Coordinator

Eugene School District 4J

THE CONTEXT

By the summer of 1984 the Eugene (Oregon) School District had acquired several hundred microcomputers with almost one-half of the machines spread across 26 elementary school programs. Of the approximately 250 micros at elementary roughly 100 were Commodore PETs, another 100 Commodore 64's and the remainder Apple IIs. This hardware alone represented an investment (over six years) approaching one quarter of a million dollars.

Classroom computer use had been very spotty among teachers and very diverse across classes. As is probably typical of many schools and districts across the country computers seeped into classrooms - secondary as well as elementary - because of individual teacher initiative and effort. It seems accurate to say that the computer revolution is being led by individual teacher entrepeneurs whose influence on colleagues spreads fast but unevenly across their respective schools. So we find pockets of intense computer activity with students while many other classrooms do not see a computer between September and June. The implications for instruction and program sequence are vivid: a fifth grade teacher plans to borrow one computer for an introductory unit only to discover that, as fourth graders the previous year her students spent a good deal of time learning to program in BASIC or Logo!

By the end of the 1983-84 school year we were finding many reasons to give order and coherence to computer use at elementary. Given the rate at which resources were being committed to computers it was clear that accountability would soon raise its head. Another concern was the incredible range of computer activities that various elementary classes were being exposed to,some of them ingenious, and others inappropriate. And finally came the articulation issues, not just between grade levels within an elementary school, but also between the feeder elementary buildings and their middle schools. It seemed clear that with six year's experience in trying out the microcomputer at the elementary level, this particular innovation was going to stay, but also that to capitalize on its best uses there needed to be more focus and coherence to how they would be used.

THE PROGRAM PROPOSAL

Six computer-using elementary teachers worked together last summer to define the structure and rationale for our K-5 computer sequence. (Shortly after that workshop concluded I was disappointed that we had not produced more of the planned units, but now twelve months later I am amazed at how much that work team has in fact accomplished.)

Listed below are the first decisions reached, the program attributes we would adhere to. The elementary computer program should be:

A.	IMPLEMENTABLE:	Manageable and carefully integrated into the existing curriculum
	AVAILABLE:	Use software and applications that are widely available
	INCLUSIVE:	Include all students in all elementary grades
	EXPANDABLE:	Elastic framework for growth and extension

TANGIBLE: Clearly defined student objectives with visible results for parents

TRANSCENDENTAL: Surpass ordinary means of instruction

FOUNDATIONAL: Building blocks for future extended studies

REALISTIC: Given existing hardware, software, and budget constraints

B. Computers should be considered not as a separate subject, but as a learning tool to support, and be integrated into, the regular curriculum. The program should ideally be implementable with either computer labs or with computers dispersed around the school; with different mixes of Apple and Commodore 64 hardware; and with modest numbers of computers available in each school.

C. All computer-related activities within the program fall within one of six strands or themes, each of which will be tended every year from K-5 in a spiral fashion.

Strand 1: GRAPHICS - Students will have opportunities to generate graphic representations for art, communications and feelings.

Strand 2: KEYBOARDING - Students will, by the end of 5th grade, be able to touch type at a speed faster than they can write legibly.

Strand 3: WORD PROCESSING - Students will become proficient at composing written work using simple word processing program.

Strand 4: PROBLEM SOLVING - Selected software will give practice in math problem solution strategies to complement Open Court series.

Strand 5: LOGO - Students will learn parts of the Logo language for the purposes of machine control, problem solving, and graphics.

Strand 6: COMPUTER TOPICS - This final strand will contain other computer-related subjects not long enough to be entire strands in themselves (e.g. legal issues, privacy, careers, etc.)

D. Teacher training requirements implied by the program are extensive because the model does not advocate a single computer specialist in each building who is responsible to teach the computer skills. Instead, the program calls for all elementary teachers to become competent enough to teach the six strands for their respective grade levels. Consequently, the writing team agreed to "overwrite" the teacher materials for each strand: they are scripted presentation formats with careful attention to listing learning objectives and all materials required for each lesson. Our belief is that relatively less-skilled teachers would find such a guided format helpful while more proficient computer-using teachers will not feel rigidly bound by it.

E. The proposed program has two significant omissions; it contains neither BASIC programming instructions nor computer-assisted-instruction (CAI). We believe that the former is inappropriate for elementary level instruction and that most existing CAI programs are of transient utility. Those which teachers have found useful will undoubtedly continue to be used as supplementary activities.

FIELD TESTING

Between January and June, 1985, we have field tested the GRAPHICS, KEYBOARDING, and WORD PROCESSING strand materials with approximately eight hundred students in grades K-5. Six elementary schools agreed to be field test sites with six teachers (one each representing each grade, K-5) serving as test classrooms. One of our selection criteria was that not all the field test teachers be computer-skilled. We tried to have the whole range of computer skills from absolute novice through machine language programmer represented among the 36 cooperating teachers.

The initial training for each of the three tested strands took one-half day and was presented by the writing team which had developed the materials. Beyond a literal hands-on walk through for each lesson the training groups also focused on implementation strategies of particular importance in schools where hardware was in short supply. The mathematics of our program design yielded the number 8 as a minimally adequate answer to how many computers would be required to implement the program. But as all school veterans know, all kinds of things happen within a school day to complicate life and program precision!

Teachers were provided at the training sessions with the printed materials for that particular strand as well as the software needed. The idea was to minimize lag time between training and implementation with kids; teachers were encouraged to begin working with the units immediately after completion of their training.

Evaluative information has been collected via two strategies, one informal and one highly structured. Teachers were asked to jot comments, questions, and criticisms on the back side of each lesson page immediately after teaching the day's lesson. We expect that these "stream of conscious" comments will be invaluable to the writing team when they revise the strand materials this July (1985).

A concurrent formative evaluation design was negotiated with four graduate students at the University of Oregon who were looking for just such a task to meet course requirements in their graduate Computers in Education program. All four university students are experienced classroom teachers with extensive backgrounds in instructional computing. They have gathered extensive data from frequent interactions with participating staff, students, and the six field test school principals. Their data and recommendations will be made available to the writing team when it meets in mid-July to revise the field tested materials (and to write drafts for field testing next fall of the other three strands - PROBLEM SOLVING, LOGO, and COMPUTER TOPICS).

THE PROBLEMS

We remain confident that we are on the right trail, but that optimism does not mean the program is without problems in both design and implementation.

1) THE CROWDED CURRICULUM - "What can we throw out to make time available for the new subject"? This plaint is probably endemic to the concept of a required curriculm. Our strategy of integrating the computer as tool within the conventional subject areas, rather than treating it as an additional new subject in its own right, helps to reduce the "weight" when adding computers to a classroom. But the problem is a serious one given the finite instructional day and the diverse pulls on teacher time. I think it fair to say, however, teachers who are convinced that computers are an important resource for learning manage to make time available while teachers who are not so convinced can't seem to find the time to incorporate them.

2) STIPULATED VS. GENERIC SOFTWARE - We may have made a serious mistake in stipulating selected software then building the units tightly around these particular tool programs. Probably the most frustrating job undertaken by the writing team was to identify "the perfect" software to be used within each of the program's strands. Each time they thought they had it yet another new program became available that looked even better. (This was particularly true in the Graphics and Word Processing strands). The wiser course might turn out to be one which suggests rather than stipulates software titles, with instructional units written more loosely to accommodate generic tools. We may have built in obsolescence.

3) SOFTWARE SURPRISES - Given the requirement noted earlier that software selected for the strands must be available for both the Apple and Commodore 64 we had to settle for certain choices that were not optimal. (Bank Street Writer became our word processor for that very reason.) But we were surprised to discover that some programs, although available for both brands of computer, are quite different when compared. The Commodore 64 version of "KidWriter" is not only materially different from, but an improvement on the Apple version. The lesson here is to examine carefully all the different implementations of a program you select for use. We did not do that and were rudely surprised.

4) LABS VS. DISPERSED - We had hoped to develop program content in such a way that different schools could implement it in different hardware configurations. Although the research done by Henry Becker (at John Hopkins University) indicates greater frequency of use for computers if they are gathered in a lab setting, there are still some good reasons why a school might instead have their computers dispersed among classrooms. We had hoped that program flexibility would permit the field test schools to "have it their own way", but the program has not worked well in the dispersed setting because of its consquence that very few students can work at the computer at any one time.

5) THE LOGO PROBLEM We may drop Logo altogether as a main strand for the program - and if we keep it we will probably select a commercially produced Logo sequence rather than insist on writing "a better one" ourselves. Two problems inherent with Logo seem more serious than they did twelve months ago; they give us new reason to pause. The teacher training requirements for Logo appear to be substantially beyond our prescription for a half-day orientation to each strand's content. Logo is at once so invitingly seductive, yet so deep that it seems trivial to dose the teachers with four hours of turtle graphics, pronounce them trained in Logo, and send them back to share it with students.

The other looming question with Logo comes out of recent research studies which question its efficacy as a problem solving/thinking tool. In an elementary context where most Logo-using teachers are probably not competent with the list processing capabilities of this language, and whose skills stop with the writing of simple turtle procedures, it looks prudent to go slowly with Logo.

6) FUNDING FAILURE - This program design cannot be cheaply implemented. The proposal in Eugene District 4J called for almost two hundred thousand new dollars for the 1985-86 budget to make implementation possible at 26 elementary schools this fall.

The District Budget Committee in April, 1985 elected not to provide the additional funds required to proceed with full implementation. We are consequently left with an optional program where the schools will undertake only those strands that they can afford using building level funds. David Moursund calculates that a school district should annually spend 2% of its operating budget to support instructional computing - he refers to it as "The 2% Solution." We are a far cry from that level in 1985.

7) *The Oppostion Coalesces* - Before there is a program to react to, many teachers who doubt the value of computers in education (and especially in *elementary* education) have no specific target to focus on. But now that the proposal exists and has specific implications for all elementary teachers, those who are fearful have actual grist to work on. We have made a strategic mistake during the past year by focusing almost exclusively on program development and training specific teachers - a short-sighted variant of "converting the converted." It is now clear that we still have a great deal of convincing to do prior to the training for program implementation for all students at all levels.

RESEARCH ON COMPUTERS AND WRITING IN GRADES ONE THROUGH SIX

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Many computer educators, researchers and teachers are enthusiastically endorsing the use of computers in writing (Hennings, 1982; Newman, 1984; Arms, 1982). Largely these testimonials result from personal use, their use with students in writing, or their use as a writing tool by professional writers (Newman, 1984). Such reports lead us to believe that there are distinct advantages to the use of computers in composition. One often-cited advantage is that word processors make revising easier (Graves in Green (1984); Papert, 1980; Collins, Bruce & Rubin, 1982). And students say they prefer writing with computers because it is physically less difficult, revising is easier, and the final product is neater and cleaner (R. Boone, personal communication, June 27, 1985).

Students' access to computers is increasing along with the interest in word processing. A recent survey found that 50% of the secondary students in four high schools in Eugene School District 4J, Eugene, OR, had access to a computer at home or at school. Word processing was the most common school use, and at home, excluding "arcade" games, the majority of student time was spent on word processing (Carey, 1985).

Clearly students prefer writing with a word processor. It was been endorsed as a valuable writing tool, and many students now have access to one at home and at school. But does the quality of writing improve as a result of using the computer in composition? The answer is best determined by using trained readers to evaluate actual student writing samples, rather than by using a multiple choice test format that tends to limit measurement to subskills such as capitalization or punctuation.

Review Procedures and Research Findings

A recent search of the literature was conducted to examine the effects of the computer as a writing tool on students' writing in grades one through six. Ten studies were found that included a direct measure of writing quality and a pretest/posttest analysis of writing sample ratings (one study was omitted due to flaws in testing procedures).

The studies were based on earlier cognitive and developmental writing research and tended to fall into three categories: those that combined word processing with on-screen writing strategies, those that used writing programs that focused on electronic mail and dynamic support for the writer, and studies that measured the effects of word processing alone.

Programs Combining Word Processing With On Screen Writing Strategies

Three studies included on-screen prompts, questions or feedback, in addition to word processing capabilities. Prompts, questions and feedback are dervived from earlier cognitive processes research on the differences between good and poor writers. An analysis of these differences led to computer programs that incorporate writing cues. Daiute (1983) reported that computer feedback (noting possible problems) and analysis (questions to guide revision) given to eight 10-year-olds who had completed a first draft of writing resulted in increased revision of the first draft, a more efficient writing style, more revisions per word, and slightly more revision types. However, quality ratings (holistic scoring of writing samples) did not improve over the five-week period.

Bereiter, Scardamelia and Woodruff (1981-82) reported the use of an on-screen feature allowing 12 sixth graders to request help with sentence openers, planning strategies and spelling assistance. After three days there was no significant effect on number of words produced or quality of writing. Researchers found that students used low level skills such as "What will I say next?" rather than global planning strategies such as "Have I met the purposes of the assignment?" or "Have I convinced my audience?" In their next study, Bereiter, et al.(1981-82) attempted to include a strategy that would prevent students from using the "what next" strategy and would instead lead them to consider higher level questions as they wrote. After every sentence the program asked a question such as "Have you made your reason clear to the reader?". After three days of intervention using this questioning strategy, 36 eighth grade students scored significantly lower on writing quality ratings than those students writing on the topic without the questioning strategy. Researchers found the strategy to be too intrusive.

In all the above studies, writing quality as measured by holistic scoring of writing samples did not improve. Although significant, and certainly a promising area for continued research, the conclusions should be considered tentative at this time due to the limited number of studies, the small number of subjects and the short length of each study. The time required for students to master new skills must also be examined. Daiute (1985) cautions that students who are introduced to writing skills which higher level thinking, may actually find their writing worsen before it improves.

Writing Programs with a Focus on Electronic Mail and Dynamic Support

Several studies used electronic mail and varying degrees of writing support. These instructional writing programs incorporate computer-based "planners" and other support structures for writers, using ideas discovered by cognitive writing researchers. Programs that incorporate audience and revising groups use the findings of developmental writing researchers. Levin, Boruta and Vasconcellos

(1983), designed a program that included structured support for writing. Initially the computer controlled the writing task. Then,as students became more proficient, they progressed from sentence completion tasks to creative composing using a word processor. (Researchers refer to this as varying degrees of support or "dynamic support" for writing.) In this study students in a grade 3-4 class worked in pairs over a period of four months to produce a student newspaper using a program called Writer's Assistant. Students in the control classroom followed their normal language arts program. Results indicated that there were significant changes in the writing of children in the experimental class, both in the length of writing samples (number of words produced) and in the overall quality of writing samples (holistic quality rating). The quality and quantity of the writing in the control group remained the same.

Riel (1984) used this writing program with learning disabled students in grades three and four. In addition, students also exchanged newsletters with other students across the nation. Riel reported that the Computer Chronicles Newswire provided a writing environment where these students composed stories for other students in five sites across the nation. Most of the writing was done by pairs of students. Completed compositions were submitted to an editorial peer board which read each piece and provided feedback for rewriting. The electronic mail service encouraged students to write for an audience of peers. The researcher reported that the Computer Chronicles Newswire was motivating and that students internalized standards for rewriting. Significant improvements were noted in the quantity of writing over the 12-week period. Although quality ratings showed no significant difference, Riel did report that students were more willing to write on the posttest than on the pretest, and that editing became routine.

Using the writing program described above, Riel, Levin and Miller-Souviney (1984) found that 28 students in a grade 4-5 combination class improved significantly over a four month period in both writing fluency and writing quality.

Quill is another computer-based program that provides dynamic support for writing. The Quill writing program consists of 1) a three-day teacher training component; 2) a 20-lesson manual for teachers; and 3) writing software tools for planning, composing, retrieving and printing text, as well as sending and receiving classroom mail. Quill was evaluated by The NETWORK (1984). Two classrooms in each of three schools participated in the evaluation. Each third, fourth and fifth grade classroom had a matched control classroom in the school. The control classrooms followed their normal language arts programs over the course of the school year. Students in the computer-based writing program significantly improved ($p < .05$) the quality of their writing on expository and persuasive writing measures.

The research studies reviewed above found that normal ability classroom students improved both in the quantity and quality of their writing. One research study found that learning disabled students improved the quantity but not the quality of their writing. These learning disabled students, who started out as reluctant writers were more willing to write and revise their compositions. Two studies included a control group in the research design, which used a traditional classroom language arts program without computers. It appears that regular students who use computers along with a special writing program do improve the quality and quantity of their writing. However, does student writing improve to the same degree when both groups use a special writing program but different writing tools (word processor and pencil).

Word Processing and Writing Studies

Two studies focus on the effects of word processing on writing. Porter (1984) found that 31 ten-year-old children did not improve, either in the quantity or quality of their writing. Prior to the study these children had practiced a process-oriented approach to writing which included free writing on topics of their choice, composing, peer and teacher conferencing, revising and editing. The first seven weeks of the study were devoted to teaching keyboarding skills and word processing skills. Students composed and revised during the remaining seven weeks. Five boys and five girls were randomly selected. Their handwritten and then typed final drafts were compared to final drafts of writing completed entirely on the word processor. Porter found no significant differences between the two final drafts of each student.

On the basis of two studies, Dauite (1985) concluded that 34 seventh graders and eight 4-6 graders wrote more with pen in a 15-minute period than they did on the computer. During a subsequent 45-minute revising period, students revised a significant, but equal amount using pen and using the computer.

The two studies described above used a test/retest research design that did not include a control group. In both cases students wrote as well with pen as with the computer. Each study lasted less than six months. A longer period of time may be needed to detect the effects of word processing alone.

Summary

The studies reported lack a common focus, and consequently it is difficult to make comparisions among them. The total number of studies reported is small and the number of subjects in all but the Quill study is less than 50; thus, conclusions are tentative.

The studies on computer-based programs that incorporated writing strategies in the form of on-screen prompts, questions or feedback showed no significant gains in writing quality. The two programs described by Bereiter et al. lasted less than a week. Those programs demonstrated that students did not find the strategies helpful. The program described by Daiute lasted five weeks and students were able to use the feedback to revise their writing; however, the quality of writing did not improve.

In two studies where the writing curriculum was the same for both control and experimental groups and the single difference between the groups was the use of a word processor by one group, rather than pen or pencil, there were no significant writing improvements. Researchers who did find significant differences compared standard language arts teaching to a special writing program that incorporated word processing. These special writing programs included any combination of the following: dynamic support for writing, an emphasis on communicating with peers (electronic mail, student newspapers) or a process approach to writing. Studies that controlled for word processing alone, and not a total writing program, found no significant effects for the quality or quantity of students' writing.

Research Recommendations

Research is needed that replicates successful studies (The NETWORK, 1984; Levin et al.1983; Riel et al. 1984). Do these practices work with other students at diverse sites? In addition, studies such as the Levin and Riel studies should be designed to control separately for the variables of dynamic support for writing and electronic mail.

Researchers should investigate the part the computer plays in writing programs. It would be interesting to see if the dynamic support for writing and electronic mail concepts could be implemented as effectively with workbook, paper, pencil and the U.S. Mail.

Research on programs with computer prompts, questions and feedback needs to be continued. Research studies involving programs that use computer cues need to be longer in duration. The optimal length of time for these studies also needs to be investigated.

Instructional Recommendations

The teaching of writing requires a sound instructional program. Successful writing practices which improve the quality of student writing include: 1) an emphasis on prewriting and 2) peer and teacher response combined with more writing (Handbook for Planning an Effective Writing Program, 1983). Writing programs that use the computer to facilitate prewriting activities and make revising easier based on feedback from peers and teachers appear to be successful. Teachers should capitalize on student interest in computer technology and their preference for writing with computers to encourage students to write frequently and to revise their work using peer and teacher feedback. Teachers who wish to use computers to improve the writing of their students will find it best to use the computer as a tool in a writing program that is based on proven instructional practices.

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THE WHOLE CURRICULUM: PROGRAMMING GRADES K-6

Vic Shlom Hansen and Karen Shlom Hansen

Introduction

An elementary school curriculum should include, but not be limited to, four instructional components: Computer and Keyboard Familiarity and Functions, Software Aided Instruction, Computers in Society, and Problem Solving Skills. This presentation will focus in on what we believe to be the most versatile and stimulating area: Problem Solving Skills. To delineate our subject even further, the most common ways to direct students in problem solving on the computer are: software, both simulations and other varieties; computer languages that need software assistance; and what the computer already does naturally, that is, the BASIC language.

We are firm believers that all students should learn BASIC as young as kindergarten age and be introduced to new building blocks of it each consecutive year. Ben Schneiderman, in "When Children Learn Programming," an article in the February, 1985, issue of THE COMPUTING TEACHER gives the following rationale for learning BASIC:

-It is very easy to get started. Learning the PRINT command is all you need to begin writing programs.

-Line numbering organizes short programs. Line numbers emphasize the sequential execution of programs, a difficult concept for new programmers. Line numbers also make adding, changing and deleting lines easy.

-It uses simple control structures and data structures. Some of the very aspects of BASIC that annoy experts make BASIC useful for beginners. The flexible PRINT command, the FOR-NEXT loop, the simple IF-THEN and the convenient INPUT command allow new programmers to make rapid progress. BASIC handles strings and simply avoids confusing distinctions between real and integer variables.

-Operations on numbers are easy to program. BASIC is well designed to accept numbers in an INPUT command, store them, compare them, print them in neat columns and do arithmetic with familiar notation.

-The BASIC environment is simple and understandable. Program editing, storing, retrieval and printing are easy to learn, remember and use. Programs are often run rapidly by typing RUN, and error messages can be specific and constructive. Tracing during RUNs and fast repair encourage exploration.

-BASIC is widely available. Almost every microcomputer offers BASIC. As children move among classrooms, schools, their homes and their friends' homes, they can be quite confident that the computers they use will offer BASIC in a largely standardized form.

The next section of our discussion will present BASIC, broken down for grades K-3, that Karen has effectively developed and implemented in the primary classroom. This information will identify and define topics in the order in which we believe they should be taught. Vic will present similar information in the final section for grades 4-6. We believe that BASIC taught in this manner enriches and extends the Whole Curriculum, which includes but is not limited to, reading language arts, and math.

INTEGRATION OF CURRICULUM AND BASIC: K-3 AT A GLANCE

I. Reading
   A. Kindergarten
      1. exploration of letters on keyboard
      2. exploration of control keys
      3. use of PRINT statements
      4. use of quotation marks
   B. 1st Grade
      1. review of kindergarten
      2. line numbers
      3. use of NEW; use of RUN
      4. use of GOTO statement
      5. use of CONTROL-C
      6. use of , ;
      7. use of TAB statement
      8. creative writing
   C. 2nd Grade
      1. review of grade one
      2. LOAD and SAVE commands
      3. string variables
      4. use of TAB statement
   D. 3rd Grade
      1. review of grade two
      2. use of INPUt statement
      3. use of IF/THEN statement
      4. use of TEXT command

II.Math
   A. Kindergarten
      1. exploration of numbers on keyboard
      2. use of PRINT statement with numbers
   B. 1st Grade
      1. PRINT x+y; PRINT a-b; etc.
      2. line numbers, by 1's and by 10's
      3. text graphics

4. LO-RES 20x20 grid

INTEGRATION OF CURRICULUM AND BASIC: K-3 (continued)

C. 2nd Grade
  1. review of grade one
  2. variables
  3. LO-RES full grid (39x39)
D. 3rd Grade
  1. review of grade two
  2. text graphics with animation
  3. LO-RES with movement and color changes

The actual presentation will supply activities and ideas to assist the teacher at the various grade levels on how to teach their students these concepts and on how to manage the classroom at the same time. For our purposes here, we will furnish actual programs developed by primary students in the reading and math curriculum

I Kindergarten
  A. Reading

```
PRINT "SUSAN" (press return key)
```

  B. Math

```
PRINT 5+6     (press return key)
```

II 1st Grade
  A. Reading

```
1 PRINT "BOBBY" (press return key)
2 GOTO 1
RUN
CONTROL-C
```

  B. Math

```
 NEW
 10 PRINT "      ^"
 20 PRINT "     / \"
 30 PRINT "    / U \ "
 40 PRINT "    / S \ "
 50 PRINT "    / A \ "
 60 PRINT "    /---\"
 70 PRINT "      x  "
 80 PRINT "      x  "
 90 PRINT
100 GOTO 10
```

III 2nd Grade
  A. Reading

```
NEW
10 PRINT "ROSES ARE RED"
```

35

```
20 PRINT "LILACS ARE WHITE"


30 PRINT "LEARNING TO PROGRAM
40 PRINT "SURE IS ALL RIGHT!"
```

B. Math

```
NEW
10 GR
20 COLOR=8
30 HLIN 10,20 AT 5
40 VLIN 5,39 AT 30
50 PLOT 25,24
RUN
TEXT
```

III 3rd Grade

A. Reading

```
NEW
10 PRINT "DO YOU LIKE ICE CREAM?"
20 INPUT A$
30 IF A$="YES" THEN 60
40 PRINT "YOU'RE CRAZY! ICE CREAM IS GREAT!"
50 GOTO 70
60 PRINT "SO DO I"
70 END
```

B. Math

```
NEW
10 PRINT "HOW MUCH IS 9*3?"
20 INPUT B
30 IF B=27 THEN 60
40 PRINT "THE ANSWER IS 27"
50 GOTO 70
60 PRINT "GOOD FOR YOU"
70 END
```

Integration of Curriculum and Basic: Grades 4-6 At A Glance

So far the programming lessons with BASIC have been approached from an exploratory point of view or learning the language in a series of separate but sequential activities. At a certain point, after enough of the language is learned, the teacher can design more complex programs by combining elements already learned. During this phase the instructor begins introducing the concept of structured programming. Structured programming, according to Arthur Luehrmann, utilizes the "top-down" method of planning a program. First the student designs the program in outline form to organize ideas, then uses subroutine "packages" to actually perform each part of the program outline. In the outline the title tells the purpose of the program. The main headings tell the major ideas that will go into the report. The writer doesn't start including actual details until s/he is satisfied with the outline. Then subheadings are added that include the details in a general sense. After the subheadings look good the writer adds the necessary details under the subheadings.

The intermediate level (usually fourth through six grade) is a good place to introduce structured programming because it paves the way for a systematic, mature approach to problem solving. Higher levels of problem solving become necessary in this natural sequence.

Therefore, the 4th-6th, or intermediate level will be a combination of concepts learned in the primary unit (Karen's) and creative application to various problem situations. Some new concepts will need to be introduced at the appropriate grade level. The role of the teacher in this situation can be described as being facilitator/teacher, or "stand back and let students work". Actually, the teacher could do three things: 1) propose problem situations and possible goals, 2) suggest ways to use previously learned concepts and see that students use the concepts accurately, and later 3) help students design and think about programs using the structured programming approach.

A simple outline for the new concepts in the intermediate level might look like this.

INTEGRATION OF CURRICULUM AND BASIC: 4-6 AT A GLANCE

I. Reading
   A. 4th Grade
      1. REM statements
      2. GOSUB routines
      3. FOR/NEXT
      4. INPUT statements
   B. 5th Grade
      1. TAB
      2. HTAB
      3. VTAB
   C. 6th Grade
      1. IF/THEN

II. Math
   A. 4th Grade
      1. FOR/NEXT
      2. REM statements
      3. GOSUB routines
   B. 5th Grade
      1. HI-RES
      2. GOSUB routines
      3. RND
      4. TAB
      5. HTAB
      6. VTAB
      7. Colon (:)
   C. 6th Grade
      1. HI-RES
      2. RND
      3. GOSUB routines
      4. RND
      5. VTAB,HTAB

You should keep in mind that concepts learned earlier will also be used and new concepts are presented over again in later grades in more complex combinations. In other words, once you learn the basics you get to see what you can do with them.

The following programs are sample programs developed for and by students to demonstrate a particular concept that was introduced at that grade. Of course the programs contain concepts previously learned.

I. 4th Grade
   A. Math
      FOR/NEXT

```
10 FOR X= 1 TO 10
20 PRINT X
30 PRINT "I'M COUNTING TO TEN."
40 NEXT X
```

REM statements

```
10 REM  COUNT BY 2's
```

```
20 FOR X= 0 TO 100 STEP 2
30 PRINT X
40 NEXT X
```

B. Reading

GOSUB statements

```
10 PRINT "WAIT WHILE I THINK."
20 REM  WAIT, THEN ERASE
30 : GOSUB 100
40 PRINT "AH, NOW I HAVE IT!"
50 REM  WAIT, THEN ERASE
60 : GOSUB 100
100 FOR X=1 TO 2000:NEXT X
110 HOME
120 RETURN
```

II. 5th Grade

A. Math

HI-RES

```
10 HGR : HCOLOR=3
20 REM  POSITION FISH ON SCREEN
30 X= 20 : Y= 100
40  : GOSUB 100
100 REM  DRAW FISH
110 HPLOT X,Y TO X+35,Y-12
120 HPLOT TO X+ 45,Y
130 HPLOT TO X+ 34,Y+8
140 HPLOT TO X,Y-8
150 HPLOT TO X,Y
160 HPLOT X+39,Y-2
170 RETURN
```

GOSUB routines

```
10 REM  DRAW FACE 1
20  : GOSUB 100
30 REM  WAIT, THEN ERASE
40  : GOSUB 200
50 REM  DRAW FACE 2
60  : GOSUB 300
70 REM WAIT, THEN ERASE
80  : GOSUB 200
90 GOTO 10
```

In the above program lines 10-20 draw a face. Then lines 30-40 erase the face. Lines 50-60 draw the same face with the mouth changed, or the eyes changed from face 1. Then lines 70-80 erase the face 2. Line 90 makes the process repeat endlessly. This is simple animation, following the basic pattern of:

1. draw a picture
2. erase that picture
3. draw the first picture but change it slightly
4. erase the picture
5. go back to the first picture and repeat the process.

TAB

```
10 FOR X= 1 TO 5
20 PRINT TAB(X); "XXX"
30 NEXT X
```

HTAB

```
10 FOR X= 1 TO 50
20 HTAB X : PRINT "HELLO"
30 NEXT X
```

RND

```
10 FOR I= 1 TO 10
20 LET X= INT(RND(1)*30+1)
30 PRINT TAB(X); "X"
40 NEXT I
```

III. 6th Grade

A. Math

HI-RES

```
      10 HGR : X= 100
      20 FOR Y= 150 TO 40 STEP -10
      30 HCOLOR= 3 : GOSUB 300
      40 HCOLOR= 0 : GOSUB 300
      50 NEXT Y
      60 END
      300 REM  DRAW ROCKET
      310 HPLOT X,Y TO X,Y-30 TO X+6,Y-30 TO X+6,Y TO
X+3,Y-5 TO X,Y
      320 RETURN
```

B. Reading

INPUT

```
      10 PRINT "WHO IS YOUR FAVORITE TV STAR?"
      20 INPUT S$
      30 PRINT "DESCRIBE SPINACH IN ONE WORD."
      40 INPUT W$
      50 PRINT "HOW DID YOU FEEL WHEN YOU GOT YOUR GRADE
CARD?"
      60 INPUT E$
      70 PRINT "PICK A NUMBER BETWEEN 1 AND 100."
      80 INPUT N:IF N§1 OR N¶100 THEN 70
      90 PRINT "NAME A JOB YOU HATE TO DO AT HOME."
      100 INPUT C$
      110 PRINT "CINDERELLA WANTED TO GO TO THE BALL, BUT
SHE HAD TO DO ";C$
      120 PRINT "WHEN SHE WAS LEFT BEHIND, SHE SAID: ";W$
      130 PRINT "THEN ";S$;" APPEARED AND GAVE HER AN EXTRA
TICKET TO THE BALL.:
      140 PRINT "RUNNING OUT, SHE LOST A SHOE.  IT WAS A
SIZE ";N
      150 PRINT " THE PRINCE FOUND HER, AND THEY MARRIED.
THEY WERE ";E$;" EVER AFTER."
      160 END
```

The above program uses input in a creative way, allowing students to change the story each time they RUN it.

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COMPUTERS IN THE LANGUAGE ARTS: AN OVERVIEW

Lynne Anderson-Inman

Trying to put together an overview of computer applications in language arts instruction is something like trying to corral a herd of mythical beasts. In each case the possibilities provided by our imagination are far more interesting than the realities we are able to find. In each case also, the field of examples from which we might choose is quite large and constantly changing. Just as a corral around a few mythical beasts would in no way define the entire realm, a brief paper on computer applications in the language arts is bound to be found wanting.

So what will this overview cover? To help narrow the field of focus somewhat, primary emphasis will be on computer applications designed to improve students' skills in reading and writing the English language. To provide some structure to the overview (and to give a bit of perspective to the ideas offered for consideration) the discussion will follow a sequence that is roughly chronological. Three questions will be addressed: "Where have we been?", "Where are we now?" and "Where are we going?"

Where Have We Been?

The earliest language arts software used in schools was most often the product of some self-taught programmer's imagination. Language arts teachers were at the mercy of programming amateurs and professionals who may never have entered the classroom as teachers, had not been trained in curriculum development and, had probably never tried to teach someone to read or write prior to designing their programs. Although other curriculum areas were subjected to similar difficulties, the field of language arts instruction seemed to have more than it's share. This is probably because proficiency in reading and the other language arts is more commonly acquired in school than any meaningful expertise in science or social studies. While a noneducator might feel comfortable designing a program to practice spelling, most would not presume to develop software aimed at teaching students to solve quadratic equations.

The catalyst for many of the early language arts software programs seemed to be one of two factors: (a) an inspiration for how something familiar could be translated to the computer or (b) a desire to create something novel and fun for a specific child. The former was probably responsible for the many (often educationally unsound) computerized versions of the spelling game "hangman". And the latter often resulted in programs revealing a superficial understanding of the reading process.

Although neither of the above are bad reasons for creating software, they do not, in general, lead to software which is appropriate for classroom use. The programs are usually difficult to integrate into the school curriculum; sometimes because their developers never intended them to be used in the classroom, and often because their developers were unfamiliar with the content and sequence of what is taught in today's public schools. Unfortunately, much of this software is still in use and its continuing existence has helped to provide fuel for the opponents of computer-assisted instruction (CAI).

There are at least four major problems with the language arts software of this era. First, the programs are generally not designed to promote student success. There is usually little in the way of on-screen assistance, either prior to interacting with a program or during its use. User errors commonly result in a terse, unpleasant, or sometimes even insulting message. Seldom is there any corrective feedback to the student, i.e. information that would facilitate improved performance on future items or questions. And finally, that which is provided to reward accurate performance is often unconvincingly silly or boring upon repetition. In fact, it is not uncommon for the "reward" for correct answers to be far less interesting to students than the consequences for incorrect answers - a pedagogical mistake of serious proportion.

The second major problem is the failure of these programs to focus on a skill that is actually part of the language arts curriculum. To a noneducator, the targeted skill may look like it matches the curriculum when in reality it doesn't. For example, one program I examined tries to teach students how to figure out the meaning of a prefix by examining context clues within the word and its accompanying sentence. Although this might prove to be an interesting bit of detective work, the task required is in direct opposition to the rationale for including instruction on the meanings of prefixes in the curriculum, i.e. so that knowledge of prefix meanings can be used by students as a tool to unlock the meanings of unfamiliar words.

A third problem with software of this genre is a frequent incompatibility between the reading or language arts skill practiced and the reading level required to interact successfully with the program. It is not uncommon, for example, to find a program designed to practice primary level decoding skills that requires a student to read at the fourth grade level in order to follow on-screen directions or make sense out of the feedback provided. The argument that teachers can read the directions to students and support them while using the program indicates a profound misunderstanding of how teachers use computers in the classroom.

And fourth, most of these programs have no system for recording student accuracy or making this information available to teachers. For CAI to be useful as an instructional substitute, teachers need to be able to monitor student performance. Without this information there is no accountability for the student's time on the computer and none of the feedback needed to plan future lessons. The inattention to record keeping demonstrated by much of the early software is not really surprising since much of it was originally designed for home use. Nonetheless, classroom utitlity is seriously hampered without it.

Where Are We Now?

In the past few years a growing number of educators have become involved in the design and development of computer software. Some serve as consultants to major software development firms, some have joined with colleagues to create software for their classrooms or schools, and others have started their own software development companies. The end result is an increasing array of software that is educationally valid. Many of the programs have been designed specifically for classroom use and there has been increasing attention to the factors which make software acceptable to teachers.

Computer applications in the field of language arts instruction have benefited greatly from this involvement of teachers and other educators. Not only do we have word processing programs which are suitable for use in schools, we now have word processing programs which "grow" with children as their skills in reading and writing improve. In addition, the newer CAI programs have increasingly focused on skills targeted by teachers for classroom instruction, hence fitting more easily into the language arts curricula. There are, however, at least three features of our current situation that may not be readily apparent, and therefore deserve some special commment.

Theoretical Bias

It is important for teachers to recognize that the involvement of educators in the design of language arts software has meant that the programs reflect these educators' individual orientations to learning and instruction. Since not all educators accept the same educational theories, the software they develop will build from different theoretical underpinnings and work toward different instructional goals.

For example, reading and spelling practice constructed upon the principles of precision teaching tend to focus on specific skills for which increased speed in responding is a relevant goal. Software with a psycholinguistic orientation to reading instruction trys to capitalize on a student's existing knowledge of language, and will be less likely to break the reading task into specific skills. On the other hand, programs with a foundation in neurolinguistic processing are structured to take advantage of perceived differences in the capabilities of the left and right sides of the brain. And word processing programs designed to facilitate a process approach to writing instruction may inhibit free movement between the modes used for writing and editing.

Since teachers also attack the instructional task from a variety of educational biases, the differences found in current software may not be an unfortunate development. Effective use of existing language arts software, however, requires that teachers be aware of their instructional biases and look for software that is compatible with the forms of instruction used in their own classrooms.

Isolated Skill Approach

A second feature worth noting has to do with the specificity of the skills targeted for instruction. The current era of language arts software is comprised largely of programs designed to teach or practice very specific skills. In the area of vocabulary development, for example, you can easily find programs which provide practice on recognizing synonyms or antomyms, and there are a large number of programs which foster skill in the various types of analogies. When the target area is word recognition, programs will generally provide isolated practice on specific word types; e.g. three letters words which are phonetically regular, four letter words ending in silent "e", or perhaps, all "color" words.

Even when a more complex language arts domain has been targeted (for example, reading comprehension) the instruction or practice available in today's software is still usually skill specific. One will find, for example, individual programs designed to teach students to distinguish fact from opinion, recognize the main idea of a paragraph, or recall a sequence of events from a passage of expository writing. Only a few programs have attempted to help students integrate these skills, or use them in a context resembling the reading demands of the "real world".

There are some advantages to the isolated skill approach to software development. Since many teachers tend to structure their curriculum along similar lines, the software is easily integrated into their daily lessons. From a developer's perspective, this approach also greatly simplifies the task of constructing a program and analyzing the accuracy of student responses. Against these advantages, however, one must weigh the growing concern among professionals that isolated skill practice has limited impact on students' overall reading performance. This seems to be especially true when no attempt is made to promote the transfer of skills practiced in isolation to the task of reading in context.

Instruction Versus Practice

Very little of the currently available language arts software is instructional in nature. Most the programs are designed to provide practice on skills that have been previously taught or introduced in the classroom. As such, most of this software fits within the broad category of "drill and practice", with very few programs actually qualifying for the label "tutorial".

One of the reasons for this situation is the very different standard of performance required of "tutorials" as compared to that required of "drill and practice" programs. Software designed to supplement classroom instruction, i.e. provide independent practice on skills already taught, must only be as efficient as other forms of practice available to the student. In general, this means that the primary forms of competition for drill and practice software (from the standpoint of efficiency) are workbooks, worksheets and educational games. To use drill and practice software a teacher need only ask: "Does this program practice the skill I have taught, and, if so, is it as effective as other forms of practice I can provide?".

Tutorials, on the other hand, are designed to take over the instructional role of the teacher. A tutorial should be constructed so that the user can do something after interacting with the program that he or she could not do before interacting with the program. If designed appropriately, a tutorial should be able to replace the teacher, at least for the skill or skills targeted for instruction. The criterion for adequate performance is therefore much stricter than that applied to software designed solely to provide practice. In deciding whether or not to use a computer-based tutorial a teacher must ask: "Does this program teach the skill as well or better than I can?".

The creation of language arts software that can actually compete with the years of instructional experience and interactional flexibility of human teachers is a tremendously difficult task. To accomplish it effectively requires the combined expertise of content-area specialists, experts in instructional design, and innovators in software development. Also necessary is a level of hardware sophistication not generally available in today's schools, a willingness to move towards less rigidly linear concepts of instruction, and, perhaps most importantly, the application of results from recent investigations into artificial intelligence. In short, we are probably a long way from having a selection of truly excellent computer-based language arts tutorials.

Where Are We Going?

No overview would be complete without some attempt to see beyond that which exists, toward that which might be. The following comments do not reflect any great imaginative leap into the future, as I am not particularly skilled at such ventures into the unknown. What my comments do attempt to provide is a glimpse of tommorrow - - a projection of what we can expect to see more of, based on what appears to be successful today.

Increased Emphasis on Writing

One of the most promising uses of the computer in the field of language arts is as a tool for writing instruction. Teachers at all grade levels have found students eager to learn word processing and adept at applying their word processing skills whenever asked to write. Increasing attention has been placed on the development of word processing programs suitable for use by children and adaptable to classroom applications. Teachers of all content areas now have a common tool for assisting students to write more and to write better.

With this new tool has come the need to rethink the writing curriculum. What writing skills are needed in a computerized environment and how should they be taught? Who should teach them? Should we eliminate some existing aspects of the writing curriculum? Are there new prerequisite skills which need to be included? What is the effect of home computers on students' writing skills? The answers to some of these questions are still unknown and others are only beginning to appear. What seems to be certain is that writing instruction will never be the same. In the future, teachers searching to improve students' writing will undoubtedly look to the newest available technology and more teachers than ever before will be expecting students to write well.

Unfortunately, the increased expectations may be founded on false assumptions. Teachers have assumed, for example, that use of a word processing program would automatically result in more extensive revisions to student compositions. Although the tool facilitates revisions, this feature is unlikely to impact on the quality of compositions if a student has not learned to recognize where revisions are needed and what types of revisions would be appropriate. In other words, we still need to teach students how to revise, but the way in which we do this and the extent to which revisions can be expected may change.

A Writing-Based Curriculum for the Language Arts

Innovative computer applications have brought about a blurring of the distinctions between instruction in reading and instruction in writing. A whole wave of new products encourage student production of stories, books, and even newsletters by providing the means to combine text and graphics in interesting and exciting ways. With tools such as these, it is easy to predict increased classroom emphasis on learning to read from what one has written, or from what one's peers have written. Although the reading-writing connection has never been denied by teachers of the language arts, it has not always been so easy to capitalize on their shared features.

This blurring of the distinctions between reading and writing is also evident in the more elementary programs designed to teach word recognition and production. Because students are often using a keyboard to enter their responses, what begins as an exercise in matching sight words may also function as an exercise in spelling. At least one instructional system for primary students has consciously capitalized on the connections between reading and writing by designing a series of programs to teach beginning reading skills through computer-based writing instruction.

I suspect that this is only the beginning. With improved products for teaching keyboarding to young learners and the adoption of voice-operated input systems, possible existing barriers to a writing-based language arts program will be effectively eliminated.

Integrated Instructional Systems

As teachers gradually embrace CAI in the language arts, curriculum developers are working to provide them with integrated instructional systems, i.e. curriculum materials which integrate teacher-based and computer-based learning. The advantages to such a system evolve from the increased potential for accompanying software to fit within a larger instructional plan, i.e., match the instructional objectives of the teacher and complement the other activities of the classroom.

Two development formats seem to be evolving and I predict others will emerge in the future. The first is centered within the control of the major textbook publishing firms. Software is designed and developed to accompany an existing reading series or some other language arts program. These are currently being offered to teachers on an optional basis, similar to workbooks or other supplementary materials. The textbook series remains the core of the system, with software designed to encourage skill practice and application. Frequently included in the software package are worksheets designed for duplication, a teacher's management system, and a teacher's manual with activities for the classroom.

Instructional systems are also being designed by software development teams comprised of educators, curriculum developers, software design experts and computer programmers. In these systems, the software may be the core of the instructional program but equal attention is given to plans and materials for accompanying teacher-directed instruction. The design goal is to maximize student learning by using all forms of instructional input to their full potential, and in a manner that is mutually supportive. Instead of software that is designed to supplement already existing materials, these systems are designed from the beginning to take advantage of the unique features of a variety of instructional resources; books, workbooks, software, tapes, and, of course, teachers.

Intuitive Learning Environments

Considerable experimentation is being directed toward the creation of more effective computer-based learning environments. The goal is to find an environment that is intuitive, i.e. one that is easy to learn because it makes use of what the user already knows. The most successful existing example of this experimentation is the mouse environment created for the Apple Macintosh. The environment has a friendly feel, and the user is rarely into a program more than one layer deep. This results in easy access to all of a program's features at all times, and a feeling of user control.

Although the mouse environment has rarely been used as the foundation for a serious instructional program, the potential is exciting. Language arts software capitalizing on the windowing capabilities and mouse interface of this environment will approach the instructional task quite differently than existing computer-assisted-instruction. Due to the mouse environment's increased responsiveness and permissiveness, learners will be able to exercise more control over the structure and sequence of their learning. This, in turn, will provide a sense of autonomy that is highly motivational.

Computer-based Reading with a Purpose

Much of the previous discussion has focused on software designed specifically to teach or practice language arts skills. Although this has traditionally been the primary application for computers in the language arts curriculum, it is not the only one. Increasing interest is developing for software which provides students with a purpose for reading and writing, improving these skills by proposing a context which elicits careful application of existing skills or requires the learning of new ones. Some early entries in this field are child-oriented adventure games, loaded databases, and electronic bulletin boards.

The time has passed when the skills of reading and writing are limited in their usefulness to paper-based media. As computers play an increasingly large role in our lives, our definition of the language arts may need to be expanded. And as educators, our exploration into potential applications will need to keep pace with the emerging technology.

LASER DISC FOR HUMANITIES

Phil Kessinger

Optical videodisc technology is an information processing medium that can enhance teaching and learning in the Humanities. Any feature film, photograph, video, sound, or printed text can be reproduced on a videodisc and controlled by a computer. The basic ability to control all of these types of information in one place will indeed enhance a branch of learning concerned with human thought and relations.

Videodisc technology described here with all the capabilities of 54,000 frames of storage, still frame, random access, and other functions is a transitional technology to ever larger and faster information processing technology. In the interval educators should not look at optical videodisc technology as some "high tech" venture that is outside the classroom. Business, industry, and government have been successfully using videodisc technology since the late Seventies. Today the key ingredients for educators to develop this technology for their own applications is an appropriate videodisc player and computer, interface, and software. See Appendix.

There are three levels of optical videodisc player configurations in a hierarchy. Level I is a stand alone player that can do all of the functions of videodisc technology with a remote control pad such as still frame, frame search, scan several hundred frames, multiple speeds, and do all of these functions both in forward and reverse. A Level II player can do anything a Level I player can with the addition of an on-board 1-7 K computer to manually program any disc or to play videodiscs with a built in computer program, i.e. "digital dump". A Level III player configuration is either a Level I or Level II player under external control of a microcomputer. The following is an outline of these three Levels as they might apply to education and the Humanities.

Level I: Shadows and Light

In addition to requisite standard play constant angular velocity (CAV) videodiscs, the key for Level I is to just get started. There are a number players, particularly older model videodisc players, that will only playback videodiscs and not allow for special functions such as still frame or search frame. See Appendix. If one has a player that allows for interaction with a remote control pad the power of this technology is within reach. For example, I have used a videodisc on the Amish in America and told students that if at anytime in watching this videodisc they had a question about what was being presented they should raise their hand. I could instantly put the disc on a still frame, discuss the student concern with the class for any length of time, and continue with the film. Working with a readily accessible CAV disc, Joni Mitchell's, Shadows and Light the same process could occur. The important point is the interactive control of information for instruction and learning.

Of all the commercially available optical videodiscs perhaps 98% are Extended Play discs. These constant linear velocity (CLV) discs have an hour of information on one side encoded with lapsed time instead of frame numbers, i.e.1-54,000. Many of the functions, e.g. still frame, of videodisc technology are not available however it is possible to search to a whole minute measure on CLV discs with newer players.

Level II: A "CLASS" Example

A Level II player configuration is popular in business, industry, and government. Two factors with Level II seem most apparent for educators. The first is that these players are expensive, i.e.$1500-$2500, and beyond the budgets of most educational institutions. Second, if significant educational videodisc software is produced in the future then Level II players may become widely used because the videodisc-microcomputer technology is essentially transparent. It takes only one piece of equipment connected to a television monitor operating automatically for powerful interactive instruction and learning. The assumption here is that effective Level II software would justify the expenditure.

An interesting example of a powerful Level II application is the Chrysler Corporation surrogate travel system called CLASS. CLASS is defined as Chrysler Laser Atlas System. This is intended to be a $500 optional feature available on Chrysler cars in 1988. With CLASS one can interact with a videodisc data base of 10,000 maps of the United States by touching a small television screen in a car. This could just as easily be 10,000 art prints or 50,000 word dictionary with cross indexes for foreign languages. Again the key is that this technology is transparent and easily used. Videodiscs appropriate for Level II are available. Optical videodiscs of stills of every piece of art in the National Gallery of Art or all of the works of Vincent Van Gogh have been available for over a year. In a parallel development a recent issue of InfoWorld (7/1/85) Atari announced a CD-ROM (Compact Disc-Read Only Memory) peripheral where it takes three seconds to find every reference to a single word in a 58 million-word encyclopedia.

Level III: Lonely Are The Brave

Getting students to think is of paramount importance in the Humanities or any area of learning. Often a teacher has an opportunity to present a film to focus this thinking. Using a Level III videodisc configuration a teacher can refocus student thinking in a clear and powerful manner after a film has been presented.

Using the authoring system from Villa Alegre:Videodisc-Microcomputer Learning Kit (produced by the Videodisc Design/Production Group, University of Nebraska-Lincoln) I approached the problem of students conceptually thinking about a film shown in class using what is called a Chapter Auhoring Program (CAP) included in this kit. See Appendix. In this CAP system each videodisc is considered a file. Each file may have up to nine chapters and each chapter may have up to nine discrete retrievable video segments. Each segment can be annotated in a menu for each chapter and all chapters are on a main file menu. Thus with use of this CAP authoring system any videodisc could have an overall menu of 81 video segments (9 chapters X 9 segments = 81 annotated video segments.

The question I was concerned with is could middle school age students begin to conceptualize the political, economic, and cultural characteristics about America presented in the feature film on videodisc Lonely Are The Brave featuring Kirk Douglas.

Students were asked prior to the film to take notes on these three concepts as they appeared in various scenes in the film. This was very difficult for most students. After viewing the CAV film a microcomputer (Apple IIe) was interfaced (Allen VMI) to a videodisc player (Pioneer VP-1000). A review of the film was presented with a menu for each side (file) of the videodiscs with separate chapter menus for distinct political, economic, and cultural characteristics presented in the film.

The process was like editing the film itself. Only this CAP approach to the film was to help students conceptualize political, economic, and cultural understanding of the human condition as presented in one film. Students appreciated the clarity of being able to review the videodisc film in this manner. An important side feature is once this conceptualized understanding of a film was established in the CAP authoring system, all students in the course of a days teaching received the same quality of instruction.

Conclusion

Most computer using educators tend to think of computers as technology with alpha-numeric displays or graphics. For the Humanities or any branch of learning one should consider videodisc technology and computers as the ability to control all media for instruction and learning in one place at the same time. This is a new idea.

Appendix

Optical videodisc players have been classed in two groups, consumer and industrial. Industrial players have faster access time in frame search, improved sound reproduction, rugged drive mechanisms for constant use, readily connect to a computer for external control, and usually cost more.

Industrial Players

Model	Level	Price
Hitachi VIP-9500	I,III	$1550
Hitachi VIP-9550	I,III	$1550
Philips VP-935	III	$1395
Pioneer LD-V1000	III	$1200
Pioneer LD-V4000	I,III	$ 900
Pioneer LD-V6000	I,II,III	$1490
Pioneer PR-8210	I,III	$ 495
Sony LDP-1000A	I,II,III	$2500
Sony LDP-180	I,III	$1100

Consumer Players

Model	Feature	
Magnavox VC-8040GY	Computer interface port	$799
Pioneer CLD-900	Computer interface port Digital disc player	$1200
Pioneer LD-660		$299
Pioneer LD-700	Computer interface port	$799
Sylvania VP-7400SL	Computer interface port	$750
TEAC LV-1000	Computer interface port	$800
TEAC LV-5000SD	Computer interface port Digital disc player	$1200

Oregon Sources

Smith's (Home Furnishings)
Santa Clara
Eugene, Oregon
(Pioneer PR-8210 and CLD-900)

Video-Audio Systems
2911 West 11th
Eugene, Oregon
(Sylvania, and entire consumer and industrial line of Pioneer and Sony. Plan to stock videodiscs.)

High Tech Video Systems
12266 S.W. Schools Ferry Rd
Tigard, Oregon
(Pioneer consumer line and large selection of videodiscs.

National Sources

Great Plains National Library
PO Box 80669
Lincoln, Nebraska 68501
1-800-228-4630
(Distribute all federally funded videodisc projects, e.g Villa Alegre)

Allen Communication
140 Lakeside Plaza II
5525 Wiley Post Way
Salt Lake City, Utah 84116
Contact Steven W. Allen
(Interface devices, authoring systems, system packages)

THE COMPUTER IN COMPOSITION:
THEORY AND PRACTICE

David McCarthy

Seymour Papert has said that the way we teach math tells us more about blackboards than about the nature of mathematics. The same might be said about the teaching of composition. Since the invention of blackboards and pens, teachers have chalked characters on slate sheets, and students have penned phrases on paper. As research in psycholinguistics and cognitive psychology has begun to yield insights into how our minds tranform and process language, our bodies have remained shackled by the physical and psychological constraints of chalkboards and paper. A computer rich composition curriculum promises to resolve the dilemma. While releasing our bodies from many of the physical con=straints of the composing process, it connects our psyches with a mind tool that can enhance our logic and deepen our intuition. This paper explores some of the research bases and practical applications of such a composition curriculum.

Two basically different but complimentary approaches to teaching composition in practice today are "sentence combining" and "process." The first promotes writing maturity by developing syntactic complexity at the level of the sentence. The second sees composition as a complex problem solving task, which it breaks down into a series of of steps. Both approaches have well documented research traditions; both possess powerful implications for teaching composition in a computer rich environment.

Sentence Combining

The sentence-combining approach is built on Noam Chomsky's theory of transformational grammar. Chomsky and other psycholinguistss claim that the human mind is equipped at birth with a mental representation of the universal grammar which, by means of formal operations called "transformations," enables a speaker to generate an indefinite series of sentences (Savage, p 161).
Accordingly, traditional grammars (including the Latin-based one which is usually thought of as "grammar" in school curriculum) do little more than classify examples: they have little to do with helping us understand how language works and, for our present discussion, helping us learn how to use language more effectively. This kind of "verbal botany," which teaches students to classify parts of sentences which someone else has written, produces students who can parse sentences, but it does not help the student generate better sentences. Even classifying his

own sentences does little more than give the student a series of objective name tags for a process which he already must understand intuitively.

Since these concepts of transformational grammar are significant for the curent discussion, it is important that they be made lucid. Consider the following example:

"John kept the car in the garage."
The sentence is ambiguous. It could mean
"John kept THE CAR IN THE GARAGE," or it could mean
"John kept THE CAR in the garage."

The first interpretation is equivalent to
"It was the car in the garage that John kept."
The second is equivalent to
"The car was kept in the garage by John."
The surface structure of the sentences does not make clear which interpretation is meant. According to the first interpretation, the sentence "John kept the car in the garage" is an eliptical form of the explicit and more abstract sentence "John kept the car that was in the garage." This surface structure has been generated from the more abstract structure by the "transformation" that deletes the words "that was." Similarly, the abstract structure of the sentence "John kept the car that was in the garage" itself derives from a deeper, more explicit pair of sentences "John kept the car" and "The car was in the garage" (Mehta, 1973). Transformational and generative grammar says that it is in this way a sentence is generated through transformations from deep to surface structure.

Work done by Kellogg Hunt (1966) indicated that the surface structure of sentences generated by children has a more complex transformational history as they get older. It was subsequently posited that exercises specifically directed toward combining and embedding syntactic units would lead to more mature syntactic structures in student writing. Research by O'Hare (1973) and Pedersen (1978) indicated an improvement in both syntactic maturity and overall essay quality as a result of sentence combining instruction. Work by Combs (1977) argued that such gains lasted over time.

Because of its editing features, the word processor lends itself well to instruction in sentence combining. In group discussions the CRT can serve as a kind of electronic blackboard for presenting examples and solving problems. Virginia Bradley (1982) presents individual students with a group of sentences already loaded into the computer. For example:

An officer drove a squad car.
The officer wore a blue uniform.
The car had flashing lights.

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After a discussion of sentence-combining techniqwues, students use the wordprocessor to combine sentences.

While still discussing the computer in teaching composition at the level of the sentence, it is appropriate to suggest uses and limitations of the plethora of grammar drills and tutorials on the market. As suggested earlier, the psycholinguists' position on such grammar is that it does not teach us how to generate sentences. In addition, applied research by Elley and others argues that grammar drills alone have no effect on improving student writing: "The results presented show that the effects of such grammar study are negligible....It is difficult to escape the conclusion that English grammar, whether traditional or transformational, has virtually no influence on the language growth of typical secondary school students" (Elley, 1976, pp. 17-18). This is not to imply that grammar drills have no place in the curriculum, but merely that they will not, as a general method, by themselves, teach students how to write any better. In this respect, Southwell (1984) reports evidence of success with COMP-LAB, a series of autotutorial computerized exercises which teach five grammatical features commonly causing problems with members of ethnic minorities whose writing problems are typically associated with some sort of nonstandard speaking background: noun plurals, verb and subject, verb agreement, past-tense verbs, to be verbs. Note here the application of computerized tutorials to teach explicit remedial skills to special students. The suggestion here, as elsewhere, is that certain kinds of grammar drills are useful for remediation on an individualized basis.

Process Model

The process oriented approach to teaching composition is based on the assumption that writing is a complex cognitive process which involves numerous tasks, many of them occurring at once: analyzing audience; determining rhetorical purpose; generating and integrating ideas; concentrating on spelling, grammar and syntax. An attempt to sort these process out has prompted writing teachers to break the writing process into steps, generally called prewriting, writing or transcribing, and rewriting or revision. Each step frequently contains substeps and methods for carrying them out.

The importance of this "steps" approach is well documented. Peter Elbow, (1983) for instance, perceives writing as consisting of two kinds of thinking: "first order" and "second order." First order thinking is the intuitive, creative, metaphor-making associative process that writers such as Ornstein (1976) and Rollo May (1976) refer to as the basic creative impulse. Second order thinking refers to logical, conscious, directed critical cognition. Elbow

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associates the first stage with freewriting; the second, with revising and critical scrutiny. Research in cognitive psychology indicates that ideas are stored and accessed through an associative network (Hunt, 1983, pp. 84-120), and so it would seem that freewriting would use the autonomous generative powers of language to harness intuition. Most creative problem solving models indicate the necessity of separating the idea-generating stage from the later evaluation and implementation stages, or the "creator from the critic," in Elbow's terms.

Brainstorming, synectics, metaphor making, journal keeping, guided imagery, discussion, and numerous other techniques are traditional ways to facilitate the prewriting stage in classrooms. Group and teacher analysis, posting and reading aloud are samples of frequently used techniques to precede revision. Revision itself generally involves at best actually "re-seeing," and at worst making pro forma changes in spelling and punctuation. In either case, adequate revision may require considerable recopying. And as Colette Daiute (1983) points out, prewriting exercises may make idea generation easier, but they do little to reduce the cognitive overload involved in the revision process. The writer must hold in her short term memory numerous revision elements such as spelling, structure, concreteness, sentence length, usage, punctuation, etc. The inexperienced writer is particularly overloaded with grammatical concerns which compete with rhetorical and stylistic ones. As most teachers of composition know, student papers frequently reflect the result of these psychological and physical constraints.

The computer appears to be a useful tool for improving all aspects of the process oriented writing model. Experimenters have developed a variety of heuristic and creative invention systems to teach prewriting, have applied numerous word processors to ease transcription, and have invented both simple and complex spelling, grammar and style checkers to manage revision.

Several researchers have experimented with heuristics as prewriting aids. A heuristic is a common problem solving method or general rule of thumb which provides direction for solving a problem by dividing it into a series of smaller steps. Initially a problem solver will need to be objectively aware of problem solving steps, but as she becomes familiar with the model, the heuristic becomes internalized. Experts in various fields have always used such models intuitively for solving complex problems. A typical computer-generated heuristic used in prewriting will help the student find a topic, generate an arguement, elaborate an idea, or develop a thesis. The technique uses "open-ended programming" to elicit and then store student responses to a sequence of questions which are designed to lead her through a particular thinking process. The stored

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responses are then presented when the student begins writing the paper. For excample:

```
Please type in your subject. I am looking for 1 to 3
words.
COMPUTERS IN COMPOSITION
Great! Now let's focus on purpose. The purpose of a paper
is its goal or aim: to inform, to persuade, to analyze, to
define, to summarize etc. Review Ch. 3 in the textbook if
you need to know more about purpose. Complete the
following sentence:
The purpose of this paper is to......
ESTABLISH THE BASIC AND APPLIED RESEARCH BASIS FOR A
COMPUTER RICH WRITING CURRICULUM
Any more? If so, type it in; if not, type NO.
NO
OK. Now relax and enjoy this brainstorming session. What
special interests made you select computers in composition
as your topic?
(etc.)
```

Work done by Hugh Burns (1980) using one such heuristic helped students improve in the insightfulness, comprehensiveness, intellectual processing and overall quality of their writing. Students agreed strongly that such invention modules made them think systematically about their own writing process. Hence, the suggestion is that the model not only helps the student write, it is also a vehicle through which the student learns how to think about thinking.

A different type of computer generated invention system is represented by Rodrigues' visual synectics program (1983). Students are presented with pictures, and asked to make comparisons between picture elements and their writing topic. For example:

```
How is nuclear waste disposal like a beach ball?
ON THE SURFACE THE PLANS SEEM SOLID, BUT THERE IS A LOT OF
HOT AIR UNDER THE SURFACE.
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After a series of such comparison, the student is invited to develop one or more of the ideas further.

Helen Schwartz (1984) links a heuristic for teaching character analysis with a local area network that allows comments by the teacher and by other students. Schwartz suggests that comments from others shows the students their need for supporting opinions, and that writing to others sharpens their own critical ability.

There is adequate evidence to support the effectiveness of word processors as vehicles for aiding the transcription or writing stage of the composition process. Computer education literature as well as articles in English journals attest to the fact that students with word processors produce essays which are longer and better, and that they enjoy the writing process more. To review this literature would seem unnecessary. It is instructive to point out, though, that most such wordprocessors are devices for transcription and not the creation of text. With the exception of a few, such as Bank Street Writer, they are designed for office and business uses, and their commands may be sufficiently complex to make learning to use them difficult for students who, after all, are merely writing paragraphs. Furthermore, the editing features of traditional word processors in themselves can only encourage a kind of "surface revision" of punctuation, spelling, and sentence structure, with little attention to content and organization.

Whether word processing systems can in fact encourage students to engage in more thorough revision is not known. Text analyzers have been available for a number of years and, if nothing else, can provide teachers with opportunities to discuss elements of style which would perhaps not normally interest students. The most sophisticated example of a text analysis system is Writer's Workbench, in use at Colorado State University (Kiefer,1984). The system offers students an array of checking grams: ORGANIZATION prints first and last sentences in each paragraph; DEVELOPMENT alerts students to short paragraphs, underlines all BE form verbs, and makes suggestions on diction problems; a VAGUENESS index alerts students to vague words such as "most," "great," and "some"; SPELL lists misspelled words; CHECK points out commonly confused homophones such as "accept" and "except; PROSE compares the student's paper with acceptable standards for stylistic variables such as readability, variation of sentence types, percent of passive voice verbs, numbers of nominalizations (nouns for verbs) ;STYLE summarizes information about sentence length, word length, numbers of simple, compound, complex sentences, percents of different types of verbs, of adverbs, prepositions etc.;ABSTRACT indicates when the percent of abstract words suggests a need for more concrete detail. The users of Writer's Workbench report positive and even enthusiastic responses from students. Students using the system also show consistent improvements 40 or 50 percent higher on tests of editing skill than their counterparts. The most successful approaches to using the program consist of having students bring printouts of results to workshops and peer review sessions.

A system which integrates prewriting invention with wordprocessing and revision checking is WANDAH (Writer's Aid AND Author's Helper), developed at UCLA by Ruth Von Blum and Michael Cohen (Von Blum, 1984). The program consists of a word processor designed expressly for on-line composing, a set of computerized prewriting aids to encourage planning and the free flow of ideas, and a set of reviewing and revising aids for checking style, grammar and theme.

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prewriting aids include "nutshelling," a series of questions that ask the student to think in broad terms about rhetorical purpose;"invisible writing"; "freewriting"; and "planning," a heuristic asking for thesis and arguements. Reviewing and revising aids include word usage, spelling, some aspects of style, an overview or summary outline, a transitions aid, an analysis of BE verbs, and a system for allowing the teacher or other students to insert comments. Currently being marketed as HBJ Writer, the WANDAH system is compatible with the IBM PC. WANDAH is the first, but certainly not the last, commercially avaialable integrated composition system. Reports on its use (Gerrard 1985) are enthusiastic and positive.

Conclusion

Our instruction is only as sound as its theoretical basis. The idea of a computer rich composition curriculum rests on sound theoretical and practical bases. Explorations of the computer's use in composition discussed in this paper are congruent with psycholinguistic and cognitive psychology theories of how we process and learn language. Computer applications of these theories prove to be practical and successful ways to teach sentence combining, heuristics, transcription and revision. The next step is for us, the classroom teachers, to integrate these concepts into our own writing curriculum. Let us continue.

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WORD PROCESSING AND THE WRITING PROCESS

Randall A. Boone

Word processing has become a new educational buzz word in the last couple of years, especially with educators who are wrestling with the issue of computer literacy in their schools. Student use of word processing software to compose and print their writing is becoming increasingly familiar in school curricula which offer computers (Bruce, Michaels, & Watson-Gegeo, 1985; Olds, 1985; Pollitt, 1984).

For teachers faced with the task of implementing computers into their classrooms, word processing appears a safe, sure, first step into computer literacy for their students. But what is it doing for the students' writing skills? A look at the composition process from the point of view of a writing teacher perhaps will reveal how the new medium of word processing can benefit the student writer.

The Writing Process

Most writers will agree and indeed a review of the literature on writing confirms that writing is viewed not as a single act, but rather an on-going process consisting of several progressive stages (Graves, 1983; Haley-James, 1981; Hink, 1985). Rarely will any two authors' writing processes follow identical paths, yet three basic stages seem to occur in almost everyone's writings. The stages are often categorized as pre-writing, composing and revising.

Pre-writing may be defined as a method for generating and harnessing the inner "stream of consciousness" through planning, organizing and analyzing before composition begins. It is the motivation for writing. A child who draws a picture before beginning to write displays a not uncommon example of natural pre-writing.

Composing, the middle stage, is perhaps best viewed as the time when the writer sits down and engages in the task of writing. It may be thought of as the process of making one's thoughts concrete.

The final stage of the writing process, revision, includes not only the correction of mechanical and grammatical errors, but more importantly a "re-vision" or second look at the content of the piece of writing.

This is not to suggest that these stages are locked into a rigid linear progression. Rather, allowance for interruptions during pre-writing, composing, or revising is built into the model. Each of these three stages is a recursive implementation of the same three stages. Revision and pre-writing, for instance, may well interrupt composing quite often. The reason for this is simple: writing is generative. As one writes, new ideas are generated by the act of writing. This may cause a writer to want to make changes halfway through a story, a paragraph, or even in mid-sentence.

Researchers agree that revision, the final step, is essential to the composition process (Emig, 1978). The research of educators such as Donald Graves and well established writing programs such as the Bay Area Writing Project have as an underlying philosophy the importance of revision in all types of writing.

Conferencing

Consider the convenience if the ideas we wish to share through writing should spring forth fully mature to the page at one's behest, grammatically sound, accurate, and effective in conveying the message. We know from experience this is not the case whether it be composing a letter to a friend, working through a novel, or writing a poem in the pleasure of a moment. Thus a most difficult task for teachers is defined, that of helping children revise their writing, and even more perplexing, getting them to think about what they are trying to accomplish through revision.

Fortunately, a technique effective in helping children improve their writing by getting them to think about what they want to say is proving successful in many classrooms around the country (Russell, 1983). It is the writing conference. Conferencing with student writers is perhaps best discussed within the context of three major considerations: (a) how to encourage children to talk about what they are writing; (b) how to ask questions which will help students make their own discoveries about what is needed in the piece of writing; and (c) how to make oneself take the time to listen to the student.

These questions have no simple answers yet there is a large degree of simplicity in the philosophy underlying this process. The idea that someone else is interested in their writing is very important to children. The fact that an adult willingly and honestly wants to know more by asking questions and taking the time to listen means even more. Conferences need not always be lengthy affairs nor must they always involve the teacher. Peer conferencing and response to each other's writing by the students is not only acceptable but very much encouraged (Healy, 1980).

In the midst of this process, the writer must take notes and employ editing marks to record the ideas that come up during the conference. After the conference is finished, the student faces the job of revising, an often unpleasant task because it requires a complete rewriting of the piece.

Painless Revision

The use of a word processing program on a microcomputer may give the writer an exceptional new ability following the conferencing process, that of "painless" revision. After the writer and the conferencing partner have discussed the composition, different ideas and techniques, such as sentence combining, could be tried and either accepted or rejected without laborious rewriting. The flexible nature of electronic text manipulation would allow new ideas to be viewed on screen as real text and would perhaps give the writer a more realistic image of what is being written.

Additionally, many students do not consider print a revisable medium, opting rather to completely redraft a piece, paying little attention to what has been written previously (Calkins, 1980). They decline to employ editing marks on a first draft and then recopy based on those intended changes. Possibly it is the inflexible nature of the paper and pencil medium which causes students not to consider the revision option.

The actual writing, setting the words down on the page, is a concrete operation, yet revision done in the conventional manner must be thought of as an abstract thinking process. From a Piagetian point of view, one might expect that if a student were able physically to construct and reconstruct a piece of writing much as a child might build and rebuild structures with blocks, perhaps a new ability to visualize the piece would develop, a visualization which includes many different possibilities. The word processor can perhaps deliver this "concretization" of text construction and reconstruction for writers.

Instructional Approach

An instructional approach that focuses on the content of writing rather than mechanics, grammar and spelling, areas which comprise the major thrust of many traditional approaches, would likely be the most effective setting for a word processor-based writing program.

Writing teachers who subscribe to the "process approach" for composition instruction are more likely interested in the revision capabilities of the word processor because it allows for endless rewrites and modifications with a minimum of effort, rather than for its ease of editing and correction of errors.

It might be expected, then, that over the course of a school year students who write using a word processor would increase the time and effort put into content revisions rather than those of a mechanical nature. Additionally, the writing medium itself presented by the word processor could help the students see composition as a changeable, revisable process, and thus provide them with an implicit inducement to revise content.

Several questions which might be answered through appropriate descriptive research include: Will students accept this revision capability and incorporate it into their writing process? What will be the relationship between the content of the conference and the content of revision or extension made in the revised draft? What level of revision (mechanics, structure, content) will the electronic revision capability encourage? How will the level and content of revision change over time? Will the amount of time spent on either revision or new writing change as the student becomes more familiar with the word processor?

The answers to these questions and more are beginning to be revealed as educators around the world look more closely at the effects of word processing on student writing. As more is learned about how word processing affects the process of writing, perhaps new and better ways of using the computer as a writing tool will be found.

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ARTIFICIAL INTELLIGENCE TUTORIALS

Seymour S. Hanfling

In the last few years Artificial Intelligence (AI) has replaced Genetic Engineering as the new hi-tech fashion to be explored by the popular press. "Machines that think" have been touted as just around the corner, if not already here. This paper will briefly explore the use of AI in educational tutorials (often referred to as Intelligent Computer-Assisted Instruction, ICAI).

What is Artificial Intelligence?

Finding a standard definition of A.I. is almost impossible. Different authors invariably give different definitions. Part of the problem revolves around attempting to define intelligence, which Brown (1984) stated is like trying to hit a moving target. An interesting definition of AI was given by a founder of AI who described intelligence as "that attribute of human behavior that we admire but do not understand" (Brown, 1984).

Since intelligence is not easily defined, it is understandable why the discipline of AI produces so many definitions of itself. There are, however, similar conceptual threads that run through most of the definitions. The problems tackled by AI seem to involve uncertainty, ambiguity, and complexity. Algorithmic solutions for these problems do not exist and answers are found by some controlled rather then exhaustive or random search (Richardson, 1983).

The idea of a controlled search implies that there is some knowledge base to be searched. In fact AI is concerned with several types of knowledge: procedural knowledge (how something is done), declarative knowledge (functional or structural knowledge), and control knowledge (problem solving and inference strategies). These form the two basic components of all AI programs.

- How can large amounts of knowledge be represented so that it can be efficiently accessed?

- What kinds of problem solving and inference methods can effectively search the knowledge bases?

Another concern that became apparent in the early development of AI programs was the distinction between machines that behaved intelligently and those that could explain their behavior so that people could understand them. In the later case this might mean developing programs that functioned as we think human intelligence does. Generally most programs were not designed to replicate human thought, since in many cases we do not know how people think. Rather they were built with modules that could explain how a decision was reached. It is this class of programs that became

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important in the development of ICAI.

All of the above concerns are still being intensively explored. The field of Artificial Intelligence is a young discipline in which the concepts and knowledge that have been discovered and developed have mainly shown how much is unknown.

Intelligent Tutorials

Computer-Assisted Instruction

In the beginning there was (and still is) Computer-Assisted Instruction (CAI). In the 1960s and early 1970s many projects explored the uses of CAI. Some of the first programs were no more then "page turners," or programmed texts put on a computer, and were referred to as tutorials because they introduced new material.

Students found CAI provided immediate feedback, remedial choices and enrichment exercises, private instruction (removing stigma of errors), continuous progress reports, to a limited extent instruction individualized to their own needs, and allowed for flexible scheduling. Teachers realized that they could spend more time on interaction with their students, remove some basic skill instruction to allow for more time on higher level instruction, and provide for instruction that would not otherwise be possible (e.g., ear training in music, graphic displays, simulations). Research showed that students using CAI could become proficient in the subject matter in about one third less time then those students using traditional materials, with equal or increased retention (Hall, 1982).

Intelligent Tutorials

However, even though CAI was effective, educators began to ask more and more from it. They desired programs that could

- hold dialogues with students.
- analyze student errors.
- produce explanations based upon the individual student responses and the type of material being presented.

In other words, they wished for programs that could handle situations that were uncertain, ambiguous, complex, and for which no algorithmic solutions existed: programs that acted "intelligently."

It was in trying to solve these problems that researchers in CAI turned to Artificial Intelligence for solutions. It was discovered that even in using AI techniques these are not easy problems to solve. The processes that an experienced teacher would naturally go through in working with a student--communication, forming models of the student's knowledge, questioning strategies, and subject knowledge, are all extremely difficult to represent in a computer.

In trying to represent the processes that a teacher uses in tutoring, most ICAI systems developed around four modules containing representations of the subject material, the student's knowledge, tutoring strategies, and a means to communicate. Appreciating the difficulties in designing intelligent tutorials can be seen by examining each of these modules separately (Woolf and McDonald, 1984).

Expert module. Just as teachers must have knowledge of the subjects they are teaching, so must computer programs. This may be as simple as a module that can analyze 2 + 2 = 4, or as complex as one that can test and debug hypothetical malfunctions in electronic circuits (Brown, Burton, and de Kleer, 1982). The expert module compares the student's responses against its knowledge base. This does not mean that it is always necessary for the expert to know the correct answer, but only to be able to recognize incorrect student responses.

The expert modules became more sophisticated as heuristics, which allowed for comparisons in the processes that produced solutions, were added. This also allowed for the examination of ranges of answers or correct answers expressed in formats differently then the expert might. Another important outcome of the use of heuristics has been that it allows the expert modules to explain their own problem solving reasoning.

Student module. This part contains information about the student's knowledge. It can be difficult to form an accurate picture of a student's knowledge. Early ICAI programs usually had very simple representations of the student's knowledge that marked information as either being known or unknown. It was realized, however, that some of the following types of information would give a much deeper understanding of a student's knowledge if they could be represented.

- If a student does not use a piece of knowledge is it because the student really does not know it or has just chosen not to use it?
- How is a student's response or solution analyzed if it is correct, but produced by a very inefficient means?
- How is correct reasoning based upon faulty assumptions analyzed?

To deal with these problems various types of student models have been developed (Sleeman and Brown, 1982). The overlay model represents the correct student knowledge as a subset of an expert's knowledge. The differential model views how the student's behavior is critically different from that of an expert. Both of these models use a subset of the expert module's knowledge in representing the student's knowledge. Other models assume that the some student errors are not made from incorrectly following correct procedures, but from correctly following incorrect procedures. Since the procedures themselves are incorrect they would not be represented in the expert's knowledge base and so the student's knowledge could not be accurately represented by using a subset of the expert's knowledge.

Tutor Module. This segment is concerned with when to interrupt a student's work and what to say once the interruption is made. Some of the different interruption strategies teachers use depend upon

- whether new material has just been introduced,
- similar responses have already been made by the student,
- the student knows the material and made a careless error,
- exactly what the student does know is uncertain,
- the need to give the student positive reinforcement,
- the student asks for help,
- and other individual teacher strategies.

There has been some interesting work done in the development of tutoring modules. SOPHIE (Brown, Burton, and de Kleer, 1982), WEST (Burton and Brown, 1982), GUIDON (Clancey, 1982) are all programs that put a great deal of effort into the development of tutoring strategies. One of the most sophisticated tutoring concepts created has been used in Meno-Tutor (Woolf and McDonald, 1984). This is an attempt to try to develop a general framework within which various tutoring rules can be defined and tested. It is not meant to be used with any one subject, but rather as structure in which to conduct experiments with different tutoring strategies.

Communications module. Teaching revolves around the ability to communicate. An intelligent tutorial is no exception. Yet the ability of a program to communicate through the use of natural language (i.e. English) has only partially been solved. Understanding the ideas and concepts of a communication is an even more difficult problem then just decoding the meaning of a sentence. For example, the sentence "I saw the man on the hill with the telescope" has three possible interpretations. Human beings make use of context, tone, and pitch, as well as visual and body cues, in understanding spoken language. An ICAI program, however, can only rely on one type of input to try to make sense of a student's response. A further constraint is that this analyzation must take place quickly--in real time.

In most tutorials the communication modules have at best been adequate. There have been some exceptions such as SOPHIE and GUIDON. However, most researchers recognize the difficulties involved in natural language and seem to be waiting for the people studying this field to develop workable interfaces.

This lack of adequate natural language processors has caused developers to look for other ways to communicate with the user. The use of graphics seems to be an excellent alternative for some projects. STEAMER (Hollan, Hutchins, & Weitzman, 1984), being developed by the Navy, is a computer-based system that provides instruction in steam propulsion engineering. It uses graphics to represent the highly abstract, mathematical model of a ship's steam propulsion system.

Mathematics is an area in which the use of natural language is not required. Mathematics has its own well defined language in which to communicate, as well as naturally lending itself to communicating with graphics. TRIP (Gould and Finzer, 1981) and Programming by Rehearsal (Finzer and Gould, 1984) are two interesting programs that use graphics as their main form of communication. The concepts they illustrate may be very useful as microcomputers with more powerful graphic capabilities become available.

The total tutor. Each of the above modules have been developed around concepts and principles that in most cases are vaguely understood. The issues involved are not generally ones of computer technology, but rather those of cognitive science, learning theory, and teaching strategy. Issues such as how do we

- store and retrieve information?
- form mental models and incorporate new ideas?
- teach different types of material to different students?
- understand and generate language?

need much more research.

The Present

The types of modules examined are very complex. They need large knowledge bases and many sets of rules to function. In general the ICAI programs that have been developed have run on mainframe computers or mini-computers. The subject areas explored in these programs have been very narrow since they usually have been developed as research experiments. There have been no full courses developed using ICAI techniques, due to the complexity of the task, as well as the lack of financial resources necessary to attempt them.

Most funding today in AI is military related. So only those topics that have direct applicability to the military are receiving large amounts of money. Many educational areas do not fall under these guidelines.

The Future

As the computing power of mainframes and mini-computers become the microcomputers of the future the hardware restrictions of the past will disappear. Dede (1985) has hypothesized a rapidly improving ICAI program that is due to "a dedicated national research program, the emergence of a collective school market, and major societal requirements for adult retraining combine to produce a rapid evolution of AI-based instructional devices." Using this scenario, by the year 2000 he predicts the following will be available at a cost comparable to human instruction:

ICAI

- mixed initiative, dialogue based tutors
- complex, interactive games and simulations with embedded coaches

Other AI

Some of the following may be done either with or without using AI techniques.

- "microworlds" (limited alternative realities) with domain dependent languages to facilitate exploration (e.g. LOGO)
- "ideal processors" which allow the interconnection of concepts in an elaborate network
- sophisticated "empowering environments" for artistic, musical, symbolic expression
- surrogate travel and experience via interactive telecommunications and videodisc
- powerful, linked data access and management devices.

Dede mentions that the above will only occur with a "national mandate for strong universal education and economic incentive for meeting this need via information technology."

Conclusions

This paper has focused on the components of ICAI systems and some of the problems involved in their development. Douglas (1985) has commented that creating intelligent tutorials may be the most difficult area AI has tackled. Teaching calls upon not just subject knowledge, but a wealth of human experiences. Grasping a student's understanding or misunderstanding of a subject, communicating with the student, creating the best sequence of instruction using student feedback, dealing with different learning styles, and all of the other techniques teachers use are only vaguely understood. Yet producing effective intelligent tutorials will be directly related to advances made in the related areas of cognitive science, learning theory, and natural language processing.

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Computers in Middle School Mathematics

Judi Mathis

> **The major influence of technology on mathematics education is its potential to shift the focus of instruction from an emphasis on manipulative skills to an emphasis on developing concepts, relationships, structures, and problem-solving skills.** [1]

This effect of computers and calculators on the mathematics curriculum is yet to be fully realized. The impact on society and changing career opportunities are reflected back on curriculums being implemented in the schools. More than ever before students need to develop versatility in their thinking skills and have an understanding of concepts, not just memorized skills. These are taught in a process oriented curriculum where math is experienced, learned and internalized. How can students learn specific skills, study details, and memorize algorithms and survive in today's society when it will change so quickly, so unpredictably?

> **No one knows where the borderline between non-intelligent behavior and intelligent behavior lies; in fact, to suggest that a sharp borderline exists is probably sillly. But essential abilties for intelligence are certainly:**
>
> **to respond to situations very flexibly;**
> **to take advantage of fortuitous circumstances;**
> **to make sense out of ambiguous or contradictory messages;**
> **to recognize the relative importance of different elements of a situation;**
> **to find similarities between situations despite differences which may separate them;**
> **to draw distinctions between situations despite similarities which may link them;**
> **to synthesize new concepts by taking old concepts and putting them together in new ways;**
> **to come up with ideas which are novel.**[2]

The computer performs long tedious computations quickly and no complaints. The human can synthesize seemingly diverse concepts from different areas to create a new idea. The computer follows an algorithm with painstaking accuracy. The human can reanalyze during the process to remove redundant steps and generate a whole new algorithm. Which parts of the curriculum are best performed by a human and which should be delegated to the computer? When solving a problem which steps should be solved using a computer and which need the special skills of the human? How will students learn how to make these decisions?

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1. National Council of Teachers of Mathematics, "The Impact of Computing Technology on School Mathematics", Report of an NCTM Conference, Fall 1984.
2. Douglas Hofstadter, Godel, Escher, Bach: An Eternal Golden Braid, page 26, c1980.

These issues must be addressed by all teachers of mathematics. The change has started. What are your thoughts and suggestions?

The extensive use of technology has not only forced this reanalysis but has provided a few creative ways to meet this challenge. The emphasis of this paper will be to highlight those areas where the computer can be used more effectively when integrated into the current middle school math curriculum and those areas of the curriculum that need some restructuring.

Middle School Recommendations

Here are some of the topics that should be included in the middle school math curriculum and some comments regarding the impact of computers.

1) **Number sense** - that intuitive understanding of relative sizes of numbers for comparison, estimation, mental arithmetic and reasonableness of computed answers.

Using a spreadsheet conceals the formulas used for calculations, this allows students to compare answers and data without being bogged down in the computation, but requires the students to estimate answers to insure the accuracy of the formulas.

2) **Problem Solving Skills** - those strategies which aid in the determination of the problem, identification of important information, notation for relationships between the variables, approximating answers, interpretting results and posing new problems.

Appropriate pieces of computer software can randomly pose a large number of problems which provide practice with various problem solving strategies. Students have individual needs and learn at different paces. Computers can provide the medium for exploration, discovery, reinforcement and challenge.

This has been the focal point of mathematic education for the 1980's. The Lane County Math Materials[3] represent an excellent collection of classrooom problems addressing this need and designed for the Middle School level. The CAPS Project[4] identified and organized a number of skills necessary for problem solving. Many pieces of problem solving software have been designed specifically to address these skills, often content independent.

3) **Visualizations** - the use of graphs, charts, 3-dimensional representations and animation aids in the teaching and learning of mathematics.

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3. Lane County Problem Solving Materials, Dale Seymour Pubs.
4. CAPS Project, AEDS Monitor, Fall 1983.

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Computer programs currently exist which plot points and equations quickly and then allow for expansions, reductions, stretching or shrinking in one direction and comparisons between various graphs. These and other visual tools will enhance both classroom presentations and student work.

4) **Data analysis** - the skills to gather data, organize it into a manageable form, choose and use appropriate graphing tools and recognize patterns.

The computer can aid in the managing, organization, calculations and presentation of the data. Programs that sort, calculate, search and xxx the data shorten the time to obtain results and encourage more analysiscan be editted

5) **Inverted curriculum** - the action of using a concept and gaining insights into when and how to use the concept before fully deriving it.

Successive approximations and iterations can be used for guessing and checking. This method for working with a problem will have longer retention and greater application for the student than just memorizing relationships and theorems.

Role of the Teacher

Problem Poser

The teacher establishes the educational goals, charts the path and selects the tools, which include the software. Problems are chosen which can be solved in more than one way and require more than one step. The teacher selects and poses problems which evolve and change as students become more adept with the tools. Many details must be planned in advance. The teacher is responsible for the room arrangement, group composition, creative problem selection and establishing the atmosphere for analytic dialog. Have students work in groups. This improves verbalization, interpretation of problems and sharing of strategies.

Facillitator

The teacher becomes an active part of this learning environment in partnership with the students without being the 'sage on the stage.' It is not sufficient that students merely find answers. Students should find solutions, often many to one specific problem, and then verbalize the methods used to find the solutions. Therefore, the teacher needs to constantly reinforce an interactive environment where students discuss problems and try alternate solutions. This verbalization will deepen the understanding, reinforce the learning, enlighten other students, improve verbal skills and provide the teacher with insights into the students' thinking processes. In addition, the teacher encourages students to pose problems to each other, other groups, even to other classes.

Mediator

A facillitator has more time to diagnose learning difficulties and prescribe appropriate remedies, so this activity of mediation varies. Sometimes it is keeping the lines of communication smooth between group members, between groups and during explanations. It could be helping students to find the most appropriate tool. The major challenge is to help students apply the newly learned concepts to new problems in new settings.

Technocrat

This does not mean being a computer scientist. This is just being comfortable with computers in the classroom, knowing when to use a calculator or a computer effectively and how to teach others to use the equipment. Modeling is a powerful teaching technique. Teachers can use the computer as a blackboard for visualization activities and for their own organizational needs.

Assign two students to each program used in the classroom. These are the experts for that specific program. When students are absent or need help this increases the number of helpers and reduces the demand on the teacher's time.

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COMPUTING AND ITS IMPACT ON ALGEBRA

By Ronald Steffani

Ever since the 1890's, when algebra became a college entrance requirement, algebra has been an important part of the secondary school curriculum. However, ever since it assumed such an important role in the curricula, there have been calls for reducing the emphasis on manipulative aspects of the subject. The last well-known attempt was in the 1960's when the Cambridge Conference proposed the inclusion of the structural properties of algebra.

During the past ten years there have been further efforts to change the school mathematics curriculum. These calls for change have resulted from changes in mathematics itself, needs of our society, and changes in technology. Within mathematics new concepts, generalizations, and skills are constantly being discovered. Within our society there is an increasing number of fields that recognize that mathematics provides a language that is necessary for solving problems. Technology, through applications of electronic computing devices, is reshaping the methods of doing and learning mathematics. All of the proposed changes are based on the assumptions that students will need more mathematics, they will need a more diverse choice of mathematical topics, and all students will need to learn a basic core of mathematics.

The above mentioned forces and assumptions will have an impact on where, when, why, and how algebra is taught in schools as well as to whom it is taught. The purpose of this paper is to discuss the changes in content, the changes in its role in the curricula, and the changes in the methodology of learning and teaching algebra that will be brought about by developing computer technology.

Changes in Content

To begin this task, we will first consider some of the skills that we expect our students to master as a result of completing a first course in algebra. One of the primary goals of such a course is that the students can solve problems using algebraic techniques. This goal involves several basic skills such as interpreting the problem, transforming it into mathematical language, simplifying the mathematical expressions of the problem, solving the problem, and checking the reasonableness of the obtained answer. If we examine a typical algebra classroom today, relative to the amount of emphasis placed on these problem solving skills, the major amount of classroom instruction is spent on teaching students how to simplify expressions and how to solve various types of equations. This emphasis of the manipulative aspects of algebra is reflected in the typical pedagogy found in algebra classes where the teacher demonstrates the rule, the students practice the seemingly unrelated rules to learn a skill, and then it is applied in traditional 'story' problems which tend to convince the students that algebra has no real world applications.

However, it is not these manipulative skills that are the heart of algebra. Rather it is the ability to interpret a problem, set it up mathematically, and check to see if the results are reasonable that are the important skills needed by students in the real world where they will work. Thus the algebra curricula should be restructured to reflect the importance of these skills instead of emphasing manipulative skills.

How can this shift in emphasis of skills be accomplished? The answer to this interrogative lies in the near future when students will all have an Algebra Tool Box at their disposal. The Tool Box will consist of an integrated software package consisting of the following tools:

1. A Calculator which will perform arithmetic operations, statistical analysis, and contain trignometric and logarithmic tables.

2. A Slate which will provide a workspace for listing and sorting information, identifying variables and their relationships. It will have graphics for problem solving and for examining the effects of changing parameter values in a problem.

3. A Data Analyzer for looking for patterns, generating functions, for curve fitting, and for regression analysis.

4. A Grapher for visulaizing equations and relationships, transforming relationships, and constructing three dimensional models.

5. A Symbol Manipulator for solving equations, simplifying expressions, finding equivalent expressions, and examining the results of one's decisions.

6. A Programming Language for designing more tools as needed, simulation of real world problems, discovering new generalizations, and demonstrating concepts.

7. A Word Processor for writing up results of a problem solving episode, interpreting the results, and describing new ideas or methods found.

8. A Tutor for learning new concepts, generalizations or skills as they become necessary to proceed, reviewing forgotten material, analyzing mistakes made, keeping records of progress made, and presenting challenges beyond the student's current level of competence.

With such an arsenal of computer power, what changes need to be made in the algebra curricula to maximize results of the mix of computer and human power? Which topics can be ignored or de-emphasized? Which skills can be left to computer power and which to human power? Which concepts, generalizations, and skills should be learned by all first year algebra students, all second year algebra students, all students who will go on to study The Calculus?

The major impact of this technology on the algebra curricula will be to shift the focus of the course from an emphasis on maipulative skills to an emphasis on developing concepts, generalizations, structure, and problem solving ability because the student's Tool Kit will do algebraic manipulations rapidly and accurately. In the September 1980 "Mathematics Teacher," Zal Usiskin set forth a list of algebraic skills which he believed must be deleted from algebra as we know it today. His rationale for elimination of the topics did not even include computer power! His contention was that recent curricular changes had added much to the curricula, but no topics were deleted and no more time was to be devoted to the study of the course. His list of topics to be deleted included: 1) Traditional word problems, 2) Trinomial factoring, and 3) Complicated fractional expressions.

His criteria for removing these topics were: 1) importance for understanding what mathematics is about, 2) understanding future work in mathematics, and 3) understanding or coping in society. All the above algebraic topics failed to meet one or more of these criteria. The development of the Tool Kit will further support his hit list.

Certainly, there are more than enough real applications of algebra so that artificial application problems are not needed. With the Tool Kit the presence of messy numbers in applied problems will be no problem and no a'priori assumptions about the appropriateness of the applied problems will have to be made.

Trinomial factoring was good for 'mental discipline,' solving quadratics, and simplifying fractional expressions. With the Tool Kit the student will be able to press the solve key and get solutions to any degree equation, or will be able to solve any equation using numeric iteration techniques, or if the student must the tutorial can remind him of the quadratic formula. There appears to be no real world problems that require trinomial factoring. However, trinomial factoring is important in calculus and in understanding the factor theorem, but this then is the time to introduce the topic, not in the course for all high school students!

Since simplification of complicated fractional expressions can also easily be done by a computer, the need for factoring is further diminished at the secondary level. Again such skills can be taught on an 'as needed' or 'on demand' basis for those, such as engineers, scientists, and calculus students who are actually in need of such skills.

The above mentioned skills may be necessary for other reasons. Perhaps they are needed to build understandings of the concepts of variable and function. Recent research on students' understandings of these important algebraic ideas do not support the idea that learning manipulative skills enhance understanding of these concepts. In fact, the understanding of variable and function appear to be very weak as a result of students completing the skill oriented algebra courses as we now know them.

Teachers of The Calculus will claim the need for students to be skilled in algebraic manipulations. However, we must consider what percentage of algebra I and II students continue on to take calculus. More importantly, the impact of computing on The Calculus will certainly change the subject itself and its traditional prerequisite subjects.

Other topics can be added to those listed by Usiskin. Simplification of radical expressions, interpolation, and polynomial long divisions are manipulative skills that can be deemphasized or eliminated from beginning algebra. The question that needs to be studied further is, what understandings would be lost if students learn to master only the simplest of such manipulations and use computer power for complex work.

In the world of the Tool Kit, what algebraic concepts and skills will need to be retained? In the new scheme of things, algebraic topics that contribute to formulation of problems and to the interpretation of results will gain in importance. The mathematical modeling process involves algebraic ideas that have received too little attention in traditional algebra sequences. The first stage of the modeling process is the problem identification stage. This stage requires the student to be able to recognize situations to which their mathematical skills might apply. The intuition for this type of thinking will come from working with and thinking about the structure of applied problems. As Usiskin said in his article, applied problems do not include the typical story problems found in current algebra texts. The Mathematical Association of America and UMAP are developing sets of applied problems which will meet the needs of developing the identification stage of mathematical modeling.

The second stage of the process of modeling involves the ability to translate the conditions of the problem into mathematical form. Intrinsic in this ability is the understanding of the concept of variable, and the heirarchy for the order of algebraic operations. To be able to successfully carry out this stage of modeling, precise language must be used, and the ability to determine relevant and extraneous information, as well as knowing when to seek needed information not already stated must be present. The present algebra curriculum does not effectively teach these skills. Only with a shift in emphasis from teaching manipulative skills, afforded by computing power, can these problem solving skills be taught.

When computing power is used to aid in the process of solving applied problems it will become essential for students to learn to interpret and check the reasonableness of obtained results. The structure of the present algebra sequence does little to enhance this ability. To perform this type of task one must be good at using units of measure, substituting into formulas, estimating and approximating, and being careful in the use of mathematical symbolism. Closely applied to these abilities is that of recognizing what assumptions have been made that might influence the outcome of the problem's solution.

Another phase of mathematical modeling is the ability to determine how the solution to the problem will be changed when one or more of the problem-setting conditions is altered. This phase of modeling involves the understanding of functional relationships. The standard algebra skill of 'solve for x' contributes to this skill in a minimal way. The concept of a function and the manipulation of functions will have to replace much of the equation solving and expression simplification which permeates contemporary algebra courses. Closely related to the understanding of function concepts is the ability to interpret graphical information. The ability to recognize and describe maximum/minimum points, intercepts, and intervals of increasing and decreasing function values are among such skills. Such quantitative thinking can be developed using computer power, and the ability to become skilled at them is not tied to the manipulative aspects normally studied in algebra.

Proposals to delete topics and to shift the emphasis of algebra instruction from manipulative skills to that of problem solving skills need to be studied carefully and critical questions need to be answered by research. However, the development of the Tool Kit software is a fact that must be dealt with. It should provide the opportunity to teach traditional topics more effectively, to resequence topics to take advantage of computing power, to make the curricula more integrated, and to extend the content of the curricula.

Changes in Presentation

Another major area of change in algebra, brought about by computer software development, will be how it is taught. The time honored sequence of teach the concept, then the manipulative skill, followed by teaching the application of the concept can be inverted. The careful sequencing of topics based on hierarchical dependencies of one skill on another can seriously be challenged. A first course in algebra should stress the basic concepts of variable, relation, function, and conditions necessary to determine the solutions of equations and inequalities. With the aid of computers to perform the algorithmic manipulations, the course could focus on the processes of expressing and interpreting quantitative relationships in symbolic and graphic form. The students could concentrate on identifying and solving realistic application problems.

The alternative approach to learning algebra could proceed in this fashion:

Step 1: Where do linear equations appear?
  a. Business and economic uses
  b. Scientific and engineering principles
  c. Statistical uses including lines of best fit.

Step 2: How can one solve a family of equations like $Ax + By = C$?
  a. Guess and check
  b. Successive approximation methods
  c. Graphing techniques
  d. Computer programs
  e. Computer software.

Step 3: Formal manipulation:
  a. Nature of the roots
  b. Equivalent forms
  c. Slope
  d. Systems of equations.

This inverted approach to teaching algebra presents several advantages over the traditional approach. It motivates by presenting algebra as a truly useful subject. It allows the student to get answers quickly and easily early in the course. It allows the formalism and manipulative aspects to be delayed until those students who select to continue their study of mathematics really need the skills. It provides students with insight into the need for mathematical modeling and encourages checking for reasonableness of results in applications. More importantly, it will allow time to be spent on conceptual development of key ideas such as functional relationships, inverse variation, and the meaning of variable.

In the new scheme of things, algebra will still be an important part of the secondary mathematics curriculum, but the topics and sequencing of ideas will no longer be so strongly influenced by its preparation for calculus role. Learning tasks and applied problem solving will not need to be so carefully sorted, separated, and sequenced based on skill oriented hierarchies. Topics from algebra, analysis, geometry, science, business, and statistics can all be integrated into beginning algebra courses once the barrier of the need to develop prerequisite manipulative skills is diminished. Additional topics from linear algebra, such as matricies, vectors, and linear programming can be introduced into the course to take advantage of their power in problem solving.

Since the students will be using computer power in many diverse ways, topics from discrete mathematics will need to be studied early in the curriculum. Concepts from Boolean Algebra, fields, logic, and laticies will be needed to fully understand the inherent discrete nature of computer hardware and software design. Even with the use of computer power in algebra, and the accompanying de-emphasis of manipulative skill learning, there are enough new ideas to be studied to warrant an allocation of more time to the study of mathematics at the secondary level.

Changes in Pedagogy

The pedagogical aspect of teaching algebra will not escape the influence to the inevitable development of the Tool Kit described above and the Tool Kits yet to be imagined. Computer technology offers the teacher a dynamic electronic blackboard for demonstrating mathematical ideas. The teacher and the learner can explore and discover concepts, explore and invent new generalizations, engage in realistic problem solving, simulate processes, and develop insights into the how, what and why of performing manipulative skills. Teachers will need to become effective problem posers and directors of independent study of students. The teacher will need to become comfortable in working in situations in which they do not know all of the answers or all of the skills and concepts needed by their students. Teachers will become facilitators of cooperative learning projects carried by small groups of students. They will have to know how to maintain effective communication with students that may be dispersed in the learning environment instead of having a classroom full of students.

The fundamental theme underlying the computer--human power mix is the emergence of new relationships among teachers, students and subject matter. A new dynamic will emerge in which the teacher will need to set up learning situations in which the learner is expected to work and think as mathematicians do, even though the student has not mastered all of the necessary manipulative skills. The computer will be used to do these manipulations faster and more accurately than the beginning student could ever hope to do them.

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DOING SCIENCE WITH MICROCOMPUTERS

Richard C. Adams

> *"Most 'Scientists' are bottle washers or button sorters."*
>
> Robert Heinlein in
> *Time Enough for Love*

What an outrageous statement!

If you have grown up with science the way I have, you know that Scientists are Truly Great People. We watched Mr. Wizard on fuzzy black and white televisions and were certain that somewhere, sometime, there was a Scientist who could answer any question that we had.

Then we got a little older and started taking science classes in high school and perhaps found out that all the answers were in some book, if we could just find out which one it was before the next test.

If we were still not discouraged by college, we might have even taken things such as Physics 101, or Microbiology, or even later the dreaded Physical Chemistry. All were touted as "real killers" and we found that the other kids were right about those courses all along.

What made science so hard and fearsome? Was it the dawning realization about just how much there was to learn in even just one field? Or was it the humility of discovering that *everyone* else seemed to know so much more about the stuff than you did? If the great god Professor Simpkins told you that He thought black was white, you'd write it down in your notebook and wait for the explanation of how you had been fooled all these years. And the explanation would always come, usually accompanied by numbers and things on the blackboard that looked vaguely somewhat like the math you were struggling with in Calculus 102.

If He were in an especially helpful mood, He might offer to "graph the equation" to make it all clear to you. After 35 minutes of flying chalk dust, erasures made with the back of His hand (blackboard erasers are always at the wrong end of a blackboard) and misplotted points, you saw a squiggly line that really didn't tell you much. Then He'd use phrases like "of course, normalized to One, and using semi-log graph paper, you WOULD get a straight line."

At that point, your eyes would glaze over and you would mumble to your fellow supplicant in the broken desk next to you, "There are some things Students weren't meant to know." and he'd nod his head in awed reverence.

But some of us survived. Some of us even went on to become Science Teachers ourselves. Why?

Put yourself in the position of people before there was Science. You could see all sorts of examples of fascinating things. There were even people in your group who would say that they could explain why these things happened. They would draw mystic signs on the ground or in chalk on a floor, and somehow that made it knowable.

Aristotle got the idea of being a very good observer and writing everything down. Later thinkers caught on to the trick of trying to group these observations together by things which seemed to "go together." It was Galileo who seems to have been one of the first to say, "Let's try it and see if it works!"

Science is NOT a book with all the answers. Science is NOT Somebody who knows all the answers. Science is NOT Professor Simpkins making everyday things obtuse.

Science is a very good way to figure things out.

Even ordinary people can use this method to determine what's true and what is not. Kids are scientists. They have curiosity and observe everything. They make hypotheses and conduct experiments to try them out. How does a child learn to speak his own language? He or she observes others making sounds with their mouths, notices actions, categorizes these actions and the sounds which are associated with them, and then tries them out. If the experiment does not work, the child makes a new hypothesis and tests that one. When the child drops a toy on his foot and says the word he heard Daddy use when he hit this thumb with a hammer, the results of this experiment sometimes urge him to revise his statement of the hypothesis. He has to modify the conditions of use or continue to get bad results.

What do we, as science teachers, do to kids to make them hate science? They have been successfully using the Scientific Method all of their lives and yet somehow we make them "Hate Science."

Perhaps it is we who have changed the definition of science on them.

I'm a high school teacher. I teach chemistry, physics, computer science, and a few other things. I know the great feeling I get, standing up there having all the answers. It's quite easy to develop a reputation as a genius simply because you've already read the textbook and many others like it, have lived 20 years longer than the kids sitting there in front of you, and don't hesitate to answer all their questions. Even if you don't know the answer, being a college graduate who has taken many essay exams in blue books, you are able to make up an answer that *sounds* as if you know what you're talking about. You can even use all those phrases you heard in college, such as "In an ideal situation...", "Theoretically...", "If you just had the mathematics I could show you...", "It's intuitively obvious that....", and even the old Simpkins Standards like "Normalized to One..." and "If I just had semi-log chalkboards...".

Giving a student the answer is very easy, but then you never teach him or her anything but facts. Showing a student *how to find out the answers* takes longer and does not immediately stroke the ego. But scientists are those people who know how to use the scientific method to find out things.

Indeed, even if a scientist is just a "bottle washer" or a "button sorter", he or she can make many observations, think up some sort of a connection, and try it out. If it doesn't work, you wash the bottles and re-sort the buttons and come up with a new idea to try out.

It doesn't take a Genius to DO science. It just takes a willingness to use a method which works reliably and keep using it until you find a satisfactory answer, or at least another set of questions.

So what does this have to do with computers?

The Good News about the scientific method is that it works. The Bad News is that collecting all that data can be damn boring.

There is a lot that can be learned about how solids and liquids behave if you just very carefully record how the temperature changes as you slowly heat them or cool them. In fact, there is an experiment in many beginning chemistry lab books that does just that with a conveniently melting solid, moth ball crystals (*para-dichlorobenzene*). Taking a temperature every 30 seconds for twenty-five minutes and then sitting down to draw the points on a graph may be beyond the attention span of many 15 year-olds. I know this 40 year-old has trouble doing it and remaining entirely cheerful throughout. What if you had a Lab Assistant who could take the temperatures and show the devloping graph as it happened? Not all of us can afford Graduate Students to do the dull, boring stuff. However, we CAN afford a computer program with a temperature probe to hook into our Apple, Atari, or Commodore 64.

Galileo dropped balls of varying mass in several fluids - oil, water, alcohol and finally air. He measured the distance by which the heavy ball beat the light ball to the bottom in units of "fingers breadth". As the medium got "thinner", the difference got less and less. From this he extrapolated that *in a vacuum*, heavy and light objects should fall with no difference in speed. He made many measurements and was a keen observer. We cannot expect all of our students to be as careful or as patient as he. A computer fitted with "photo gates" to tell when an object has passed in front of a light source can be very accurate and give precise results quickly. The boring part can be done by the computer. The creative part, the recognition of a pattern and the generation of a new idea, can be done by the student.

Sometimes, just looking at things a new way can help. A *Data Base* program can help you re-sort the buttons and try to see a new connection or regularity.

Linus Pauling used to give his chemistry lectures at California Institute of Technology with a "Blackboard Assistant" in the person of Roger Hayward, the one who contributed to "The Amateur Scientist" column for so many years in *Scientific American*. What Mr. Hayward could do was to use his vast talent as an artist to quickly illustrate theoretical concepts in colored chalk as Dr. Pauling lectured. Humans respond to visual patterns much more easily than numbers or words. If you saw a mass of numbers on a black board and were told to see where all the "467's" occurred, would it be as easily done as to see the pattern all the "red dots" formed in a sea of blue and white dots?

Roger Hayward is no longer available and none of us could have afforded his talents anyway. But we can use some of his skills. An experiment or an equation may generate a series of numbers. Looking at them and recognizing a pattern is difficult for many of us. It is not that we couldn't *understand* a pattern if we could see it, it's just that picking out a pattern in digits is extremely unlikely for most of us. Graphing these numbers will help quite a bit. Unfortunately, graphing things well takes a lot of time.

Unless we use a computer to do it for us.

In one of my beginning programming classes, the students have to make up a program that will take in any 250 numbers, adjust the height ratio to fit on the screen, draw a line graph and put a numerical scale down the vertical axis and place a title at the bottom. They all get the program done and numerical results are displayed quite quickly. Commercial programs can do better, allowing you to adjust the axes after drawing, change the scale to see if things look different, and even use Professor Simpkins' semi-log or log-log blackboard. However, all of this is done quickly, accurately, neatly, and without the histrionics of Professor Simpkins' flying chalk dust, messy erasures and those odd phrases of German muttered under his breath.

Other programs can take a graph of the points you found in the lab and generate an equation that fits the points "pretty well". You can try different types of equations on the curves and see which gets the "best fit" and gives you the nicest equation. How do you interpret the equation you get?

One of my favorite programs is "Algebra Arcade" from Wadsworth Electronic Publishing. Yes, it's a game. Yes, there are things to shoot down on the screen. Yes, they are strange aliens. On the other hand, the method of "shooting" is with an equation. On the bottom of the screen is "Y= ". You fill in the right hand side of the equation. "Y=4" will make a straight line, four marks above the x-axis on this cartesian coordinate playing field. If the line passes through one of the "algebroids", a windmilling blade will come along and drop the alien down off the graph, increasing your score. You get more points, proportionately, for the more algebroids you can get with one line. I have seen high school students with very little algebra background exploring what happens when you do "Y=X" or "Y=X+4" or "$Y=X^2$". The last equation makes a U-shaped parabola. What do you think will happen if you make that "$Y= 0.5 * X^2$"? My math education didn't get me to the point where it was "intuitively obvious" to me that multiplying a parabola by a fraction would make the whole thing wider. After an hour, kids *know* what that will do, how to modify it to move the whole thing up four marks ("$Y=X^2 + 4$"), how to move the lowest point of the curve three places to the right ("$Y= (X-3)^2$") and how to reverse the curve (use a minus in front of the whole thing).

If I had had this program available to me in high school, I could have learned much more in both science and math classes. If I'd known about it in college, I could have gotten a lot further before the "math barrier" hit me. If I'd known about it two years ago, I could have helped more students to understand what their graphs were showing.

Can computers teach the binary system of biological nomenclature? Yes. It can be as lowly as an automated drill and practice program with quick feedback or as excellent as a program which actually *teaches the logic* behind it.

Can computers help a student learn to write chemical formulas and balance equations? Yes. It can do those things quite well.

Can a computer teach Chapter 11 to the student who was gone that week at a sports tournament? Maybe not, but it could help with some of the details.

Can a computer help a student to actually DO science and feel good about it? Definitely.

Perhaps using computers to take some of the drudgery out of the scientific method will help us turn out more biologists than so many people who have "taken Biology", more chemists than people who "made it through chemistry", and more scientists and scientifically aware people, than kids who "Hate Science."

The Computer as a Laboratory Instrument in Science Instruction

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--- Introduction ---

Commercial and university engineers have been able to develop methods of using the microcomputer to assist them in the collection of experimental data in a wide variety of applications. However, the use of the computer in the schools as an actual piece of laboratory equipment has been limited if not completely absent. This is do mostly to the fact that easy to use peripherals have not been readily available to the general public. Software and peripheral developers now recognize public education as a major market for such devices.

--- Statement of Purpose ---

The following will describe the use and application of a commercially made software package for the Apple II computer titled Experiments in Science by HRM Software (A division of Human Relations Media $249.00; 175 Tompkins Avenue, Pleasantville, NY 10570 Ph.# 1-800-431-2050).

--- Product Description ---

Experiments in Science contains a good mixture of software, peripheral hardware and documentation. The main focus of the package are 2 temperature probes and a light sensor which may be used either in combination or separately in a wide range of lab experiments. The software provides a means of recording and graphically displaying data received from the the probes and/or sensor. Connecting the hardware requires plugging a junction box into the game port inside the Apple II. Probes, lights and sensors are simply plugged into the junction box as needed. The junction box also contains 2 LEDs and an external port for connecting a joystick or another similar device. The temperature probes must be calibrated to the computer to which it is connected to insure accuracy. Calibration is well directed through the documentation and the calibration program. Calibration data is stored to disk for later use.

Documentation

The Teaching Guide that accompanies the package contains complete and easy to follow set up instructions including technical information for those who wish to take things a step further.

Complete instructions as well as background information is provided for each of the 12 experiments contained on the disk. They are grouped into 4 categories as follows:

Chemistry Experiments
1. Cooling Curves
2. Heat of Neutralization
3. Chemical Reaction Rates

Physics Experiments
4. Light Intensity
5. Kinematics
6. Light-Energy Equivalence

Biology Experiments
7. Heart Rate
8. Response Times
9. Flicker Fusion

Earth and Planetary Science Experiments
10. Insolation
11. Evaporation
12. Weather Station

Although the guide provides comprehensive instructions for each experiment, the degree of conceptual and mechanical difficulty varies greatly from one experiment to the next. Fortunately, both software and hardware are flexible enough to allow for the modification of the experiments to meet the needs of teachers of various grade levels. In fact, uses of the software and hardware may easily extend beyond the scope of the teacher guide!

--- Experiment Summaries ---

The following will include the objective and a brief description of each experiment contained in the Teacher Guide. Some suggestions may also be included in each section. It should be noted that the temperature probe calibration program contains a feature which simply displays the temperature. Because of the quick response time of the probe, this feature alone may be used for a variety of data collecting such as a surface skin temperature of humans or small mammals, light energy absorption experiments, air temperature, etc..

1. Cooling Curves

Objective: To observe temperature changes as substances change state or dissolve.

Paradichlorobenzene crystals (moth balls) are heated to the melting point. The computer plots the temperature history as the chemical cools.

A vast array of temperature related experiments can be performed using this same program module. Two examples might be recording the cooling rate of water in various containers such as styrofoam, glass, alluminun, and determining dew point .

2. Heat of Neutralization

Objective: To measure the temperature change involved in a chemical reaction and to relate this change to the heat of neutralization.

The change of temperature is recorded and displayed when an acid (HCl) and base (NaOH) react and neutralize each other. The degree of change is then compared to chemical equations. Predictions of future reactions may be based on previous comparisons.

3. Chemical Reaction Rates

Objective: To study the effect of a catalyst on the rate of a chemical reaction.

The light and light sensor are used to measure the light passing through a colored solution. As the reaction takes place, the fluid becomes clear. A simple styrofoam apparatus which makes this procedure easier is included. The software plots light intensity changes over time. This is a complex experiment geared toward high school or college level chemistry.

4. Light Intensity

Objective: To use the 1/R*R law to measure the distance to a light.

The computer converts light intensity to a digital readout. It also calculates the distance between the light source and the sensor based on the intensity of the light. Alignment of the source and sensor are critical. This demonstrates the inverse square law clearly and easily. Determining the density of a photographic filter can be readily calculated in this module.

5. Kinematics

Objective: To measure the position, velocity, and acceleration of an object on graphs and to relate these graphs to the motion.

The light sensor is attached to a swinging pendulum. The light sensor plots the position, acceleration and velocity of the swinging sensor.

6. Light-Energy Equivalence

Objective: To measure the energy in light.

By measuring the light intensity on a measured surface area over a specific volume of water, the energy of the light may be calculated from the increased temperature of the water.

7. Heart Rate

Objective: To measure your heart rate and see how it can be influenced.

A light source and a sensor are held in close proximity on a finger or thumb. The pulsing blood modulates the intensity of the light received by the sensor and converts that information to a graphic display while at the same time calculating the heart rate. A temperature probe may be used to record breathing rate when held near the nostrils.

8. Response Time

Objective: To measure the speed of your response to a signal.

Response time to an audio or visual stimulus may be tested in a variety of ways. Comparing the response time to audio and visual stimuli can be quite revealing.

9. Flicker Fusion

Objective: To determine at what rate your eye can detect the flickering of a light.

Do to the eye's persistence of vision, a light that flashes at a high rate appears to be continuously lighted. The point at which an individual distinguishes a light as flashing or not varies. This test flashes a light from 12 flashes per second to 100 per second and vice versa. The person stops the sequence when the flashing appears to end or begin depending on which sequence is used.

10. Insolation (Solar Radiation)

Objective: To measure the solar energy available at potential collector sites.

By using the light sensor the amount of solar energy during specfic time may be determined.

11. Evaporation and Humidity

Objective: To investigate evaporative cooling and use it to measure relative humitidy.

Both temperature probes are used to do wet bulb/dry bulb tests on humidity. Evaporation rates are measured by putting each probe in water of different temperatures.

12. Weather Station

Objective: To see how a computer-contolled weather station could record meterological data.

This experiment uses both probes, a light and the light sensor to measure wind speed, air temperature, relative humidity, and insolation. Wind speed is determined from the rate of cooling of a probe that is heated by the light. All other measurements are carried out as they are in the previous experiments.

--- Use In The Classroom ---

How this type of apparatus is used in a classroom is dependent on a wide variety of factors. The number of computers per classroom is the biggest factor. In high schools it may be more realistic to expect to have access to one or several computer stations available for lab use. However, in the elementary and junior high levels this is probably not the case. Budget restraints may minimize the number of software packages to one per building or in small districts, one per district! For now, let's assume that a school has only one complete set to work with. This makes the use of this package limited to two major methods of instruction. One is through demonstration and the other is through a learning center approach.

Demonstrations

The key to education through demonstration is not so much HOW to demonstrate something as it is WHEN to demonstrate. I am not talking about the "how to" demonstrations where the instructor shows how to perform a task. The major concern here is in demonstrating a principle or concept. Let's take the Cooling Curve experiment as an example to illustrate the cooling behavior of boiling water. The following problem is presented to the class:

If we graph the cooling rate of the water, what shape will the line graph exhibit? Straight acrossed, straight diagonal, curved up or curved down, etc..

At this point the students draw a "rough draft graph" on scratch paper displaying their hypothesis (Hopefully, the class understands the concept of reading and constructing graphs!). Now the teacher lets the class work in small groups to carry out the experiment using "standard" lab equipment, lab thermometers, pencil and paper, etc.. NO COMPUTERS! The class reads, records and plots their data over a period of 10 minutes. When completed the class comes back together to share and discuss their results. Some have met with success while other groups have graphed "garbage "due to inaccurate readings and poor time keeping but are yet unaware of their inaccuracies. Now, the instructor repeats the experiment, this time using the computer. The class compares their data with the computer's. Assuming that the computer was successful in accurately recording the event, the students with poor results would be required to hypothesize the reasons why their set of data is inconsistent with the computer's.

Adding influential factors to the experiment gets even more "mileage" out of the lesson. Ask the students how an ice cube might affect the shape of the cooling curve, if at all, then test the predictions in the same manner as before.

Learning Centers

A learning center or lab station is feasible with some well prepared worksheets which would guide the student(s) through an experiment. A small group of self directed students (2 to 4) could work independent of direct teacher supervision if this approach is taken.

--- Final Thoughts ---

Some have argued that the computer approach to scientific experimentation takes away a certain degree of tactile interaction from the science student. Others have contended that the use of standard lab thermometers and inexpensive light meters are more appropriate to science education. I must agree to a some extent. But first, let's consider the calculator analogy before I back up my philosophy with more intellectual dribble. When the calculator was introduced into the public schools, many were afraid that mathematical thought would be reduced to mere button pushing. Now there is general agreement that calculators free workers or students of the drudgeries of math and allows them to concentrate on the process involved in reaching the solution to a problem.

The fluid thermometer is slow to respond to changes, it's difficult to read and therefore promotes greater error. It also needs constant attention throughout the course of an experiment.

The computer version responds quickly, records data automatically, displays the data in graphs and significantly reduces the risk of human error. For extended length experiments over several hours or days, the computer can continuously monitor conditions while completely unattended allowing the lab person to carry on with other activities. For the classroom, the immediate visual feedback(graphs) that is generate allows students to recognize trends or patterns in data while the experiment is still in progress. Some experiments, like the kinematics, could not be duplicated with manual instruments. This would hold true for any of the experiments where measurements must be recorded several times each second!

Computers in the Science Laboratory

Grant High School

Dennis Holm and Charles Martell

The chemistry and physics departments at Grant High School are in the process of developing equipment and programs which will enable us to use the computer as a standard laboratory tool. We are using David Vernier's software (Temperature Plotter and Precision Timer) and the Hillsboro School District's analog to digital interface board. With this equipment we will be able to use the computer to read temperatures from -20°C. to over 1000°C., time intervals of 1/1000 of a second, detect small voltages, and read the pH of solutions. The computer will be capable of reading and saving data from eight different probes at one time.

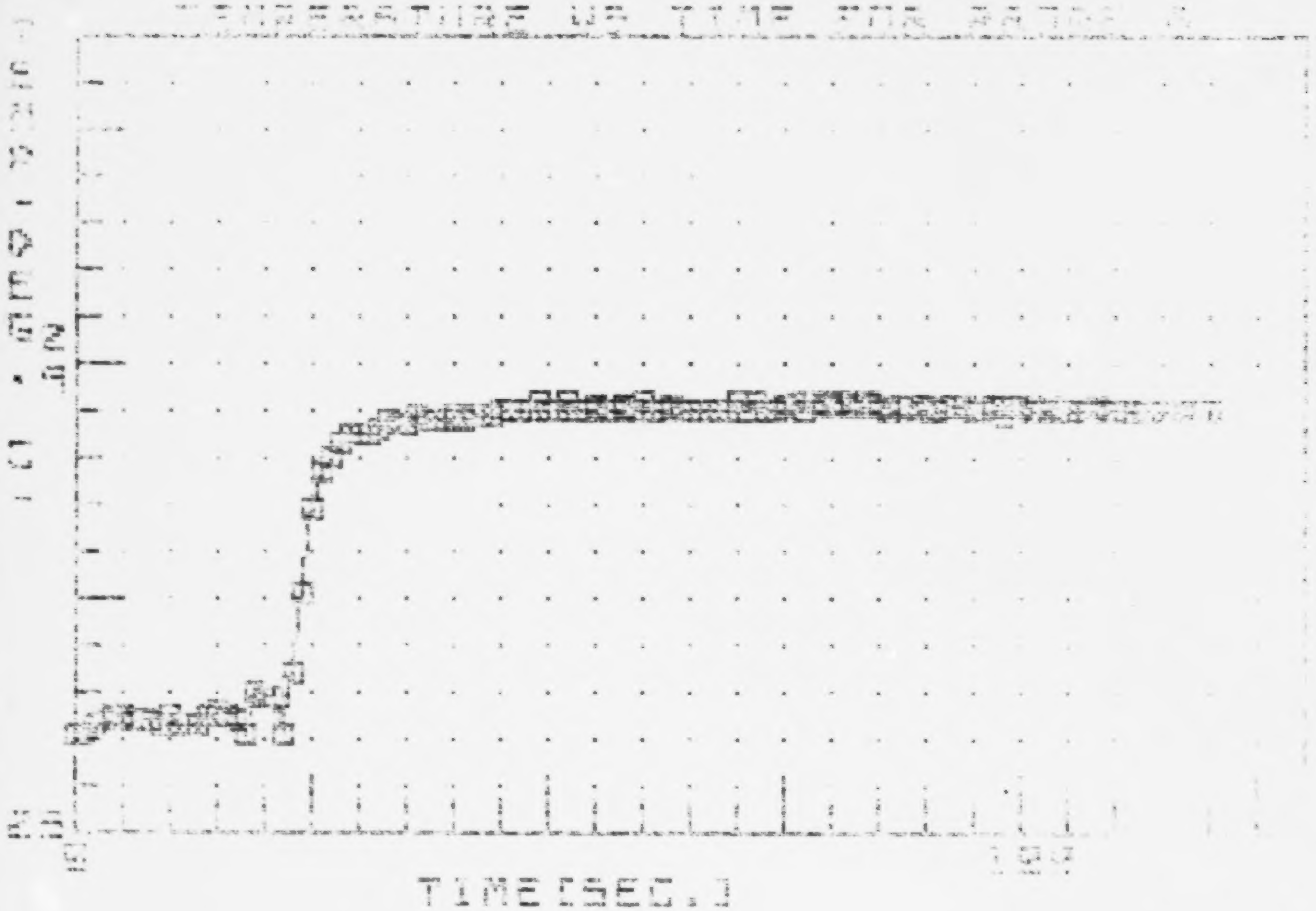
On the next few pages you will find five examples of the types of labs which can be conducted with the use of the temperature probes, pH meter, and photogates. The first graph shows the heat released when copper sulfate is dissolved in water. The second graph is the cooling curve for paradichlorobenzene (mothballs). The third graph shows the heat released, in water, for equal weights of aluminum and a rubber stopper. The fourth graph shows the neutralization of hydrochloric acid with sodium hydroxide. Finally is the results of a lab on acceleration of gravity using photogates to do all timing.

This work has been the result of a grant we recieved from Portland Public Schools. The equipment has been built from available plans and from Radio Shack parts without needing any advanced training in computers or electronics. We plan to help integrate this equipment into the Portland high schools next year.

It is our hope that this equipment will increase the precision and accuracy of our student's experiments and give them an idea of the type of equipment they might find in a college or industrial laboratory.

Computer Software
  Vernier, David, "Precision Timer."
  Vernier, David, "Temperature Plotter."
        Vernier Software
  2920 S.W. 89th Street, Portland, Oregon 97225.
Reference
  De Jong, Marvin, "Apple II Assembly Language."
    Indianapolis: Howard W. Sams Inc., 1982. 330 pages.

Heat of Solution for $CuSO_4$



5.00g $CuSO_4$ in $20\bar{0}$ ml H_2O

$\text{kcal} = (0.200\,\text{kg})(2.6°\text{C})\left(\frac{1\,\text{kcal}}{1\,\text{kg}\,°\text{C}}\right) = 0.520\,\text{kcal}$

moles $CuSO_4$ = $5.00\text{g} \times \frac{1\,\text{mole}}{159.6\text{g}} = 0.0313$ moles

Heat of Solution = $\frac{.520\,\text{kcal}}{0.0313\,\text{moles}} = \frac{16.6\,\text{kcal}}{\text{mole}}$

% error = $\frac{16.6 - 16.2}{16.2} \times 100\% = 2.47\%$

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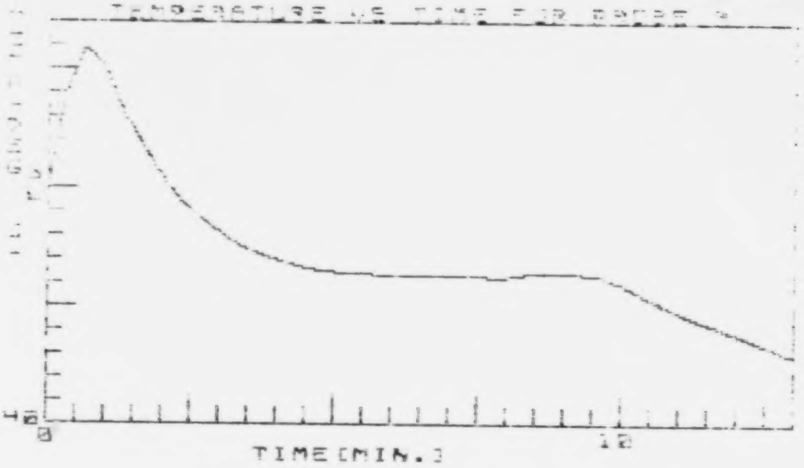
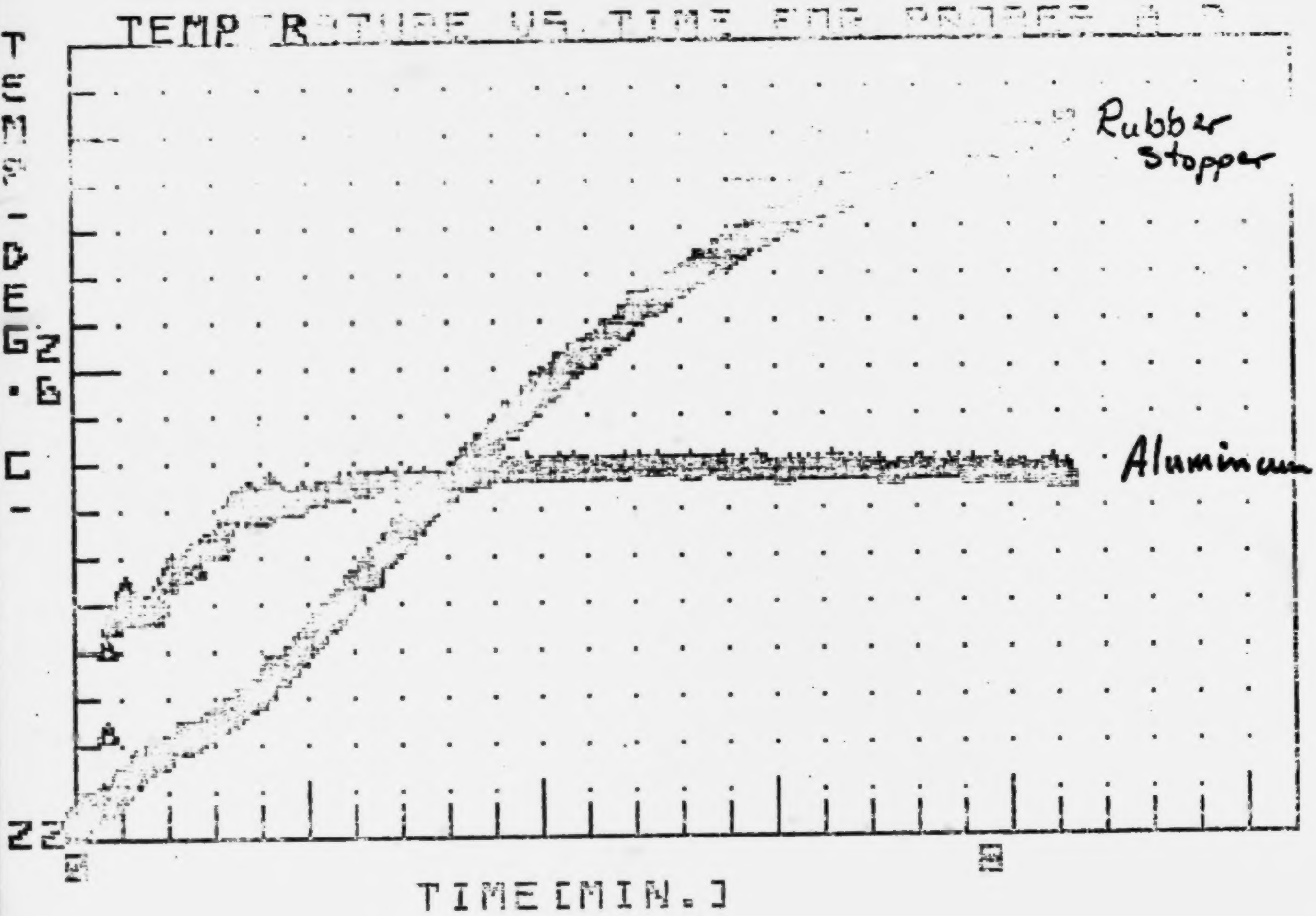
Paradichlorobenzene





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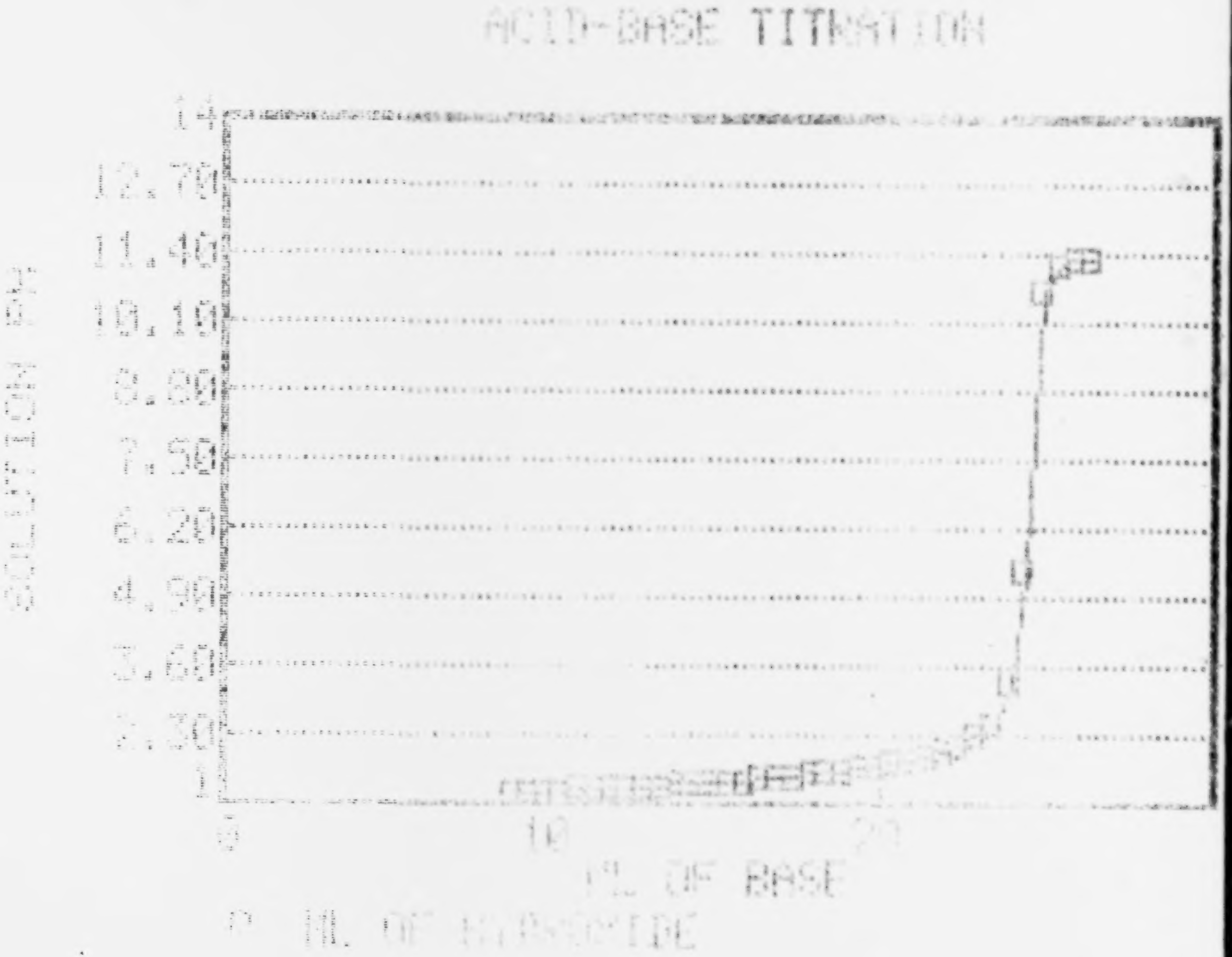
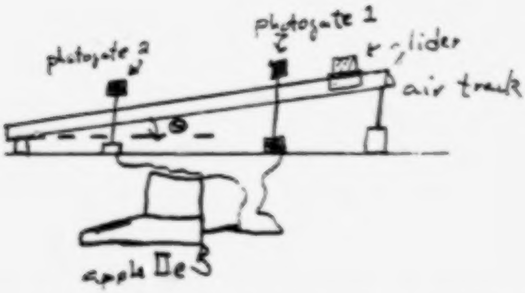


Finding g (the acceleration of gravity)

EQUIPMENT :

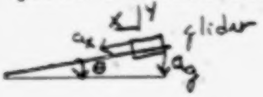


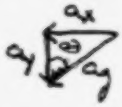
PROCEDURE : Using an air track as a frictionless inclined plane, the acceleration of a glider is found by using the computer to measure the time it takes for the glider to pass though the 2 photogates therefore finding the change in velocity. Acceleration is found using the equation a=(v2-v1)/t; where t is the time it takes for the glider to pass between the gates and v1 and v2 are the respective velocities at each gate.

DATA : I used 3 runs and found the mean. The deviation was less than .5%.

v1=1.04 meters/second
v2=1.61 meters/second
t=.50 second

RESULTS : The linear acceleration (a_x) equals 1.02 meters/second^2.
To find the acceleration of gravity the vector components of the gliders acceleration must be found using simple trig.





$$\theta = 6^{\circ}$$

$$\sin\theta = \frac{a_x}{a_g} \therefore a_g = \frac{a_x}{\sin\theta} = \frac{1.02\,m/s^2}{\sin 6^{\circ}} = \underline{\underline{9.76\,\frac{m}{s^2}}}$$

CONCLUSION : The actual value of g is 9.8 meters/second$_2$. The percent of error then in this lab is around .5% . The lab only took around 10 minutes to set-up and run so it would be possible to try other variations such as changing the angle or the mass of the glider.

COMPUTER APPLICATIONS FOR SOCIAL STUDIES

Rick Thomas

Introduction

> The topics generally included in the social sciences appear as though they would be of great human interest. But something strange seems to happen on the way to the classroom. The topics of study become removed from their intrinsically human character, reduced to the dates and places readers will recall memorizing for tests. (Goodlad, 1983)

Secondary students commonly do not like social studies courses very well. Goodlad's data reflects a student interest/importance rating below English/language arts and math, and approximately equal to that of science (Goodlad, 1983). Data from a 1977 National Science Foundation study supports the same conclusion (Wiley, 1977). The SPAN report on the Current State of Social Studies prepared by the Social Science Educational Consortium identifies a variety of factors which may contribute to these low levels of student interest and motivation (A Report of Project SPAN, 1982):

1) the predominance of the textbook as the instrument of instruction

2) a reliance on large group lecture/recitation methods of instruction in excess of 50% of the time

3) teacher perceptions of a lack of materials with which to individualize instruction

4) classroom physical impediments to small group work

5) an excessive amount of time lost to administrivia

6) a general lack of awareness of and exposure to innovations in social studies methodologies and media

7) teachers who generally do not tend to be inquirers into social issues themselves

8) a tendency to "teach the way I was taught"

From atop the crest of the computers in education wave it is tempting to represent the computer as the panacea for problems in the secondary social studies classroom. Proclamations of the advertising and popular media aside, the computer alone is not the answer. Computers do, however, have a place in the social studies classroom. Their use may promote greater levels of student interest and motivation and they may contribute to greater student achievment in areas of social studies education which have been relegated more to the domain of lip service than instruction. These possibilities will be discussed along with suggestions for the sort of research which needs to be undertaken to validate suitable and effective applications of computers in the social studies.

Potential Applications

Computers are potentially of value in the secondary social studies classroom in a variety of ways. Glen and Rawitsch (1984) identify five distinct types of applications:

1) a method of delivering content

2) a generalized tool for analyzing information

3) an example of technology used in society

4) a tool for developing thinking skills

5) a classroom management aid

The present discussion will focus on the "tool" aspect of the application of computers - both in terms of analyzing information and developing thinking skills. The role of computers in this capacity in the social studies classroom is virtually unexplored. Research in other subject matter areas, however, as well as research related to instructional practices in the social studies, and research in cognitive development is suggestive of ways in which computers might be used in these capacities. As will be noted, there are some tentative starts in the area of curriculum development and use.

A Tool for Cognitive Growth

Cognitive Development

Bruner has classified learning behaviors into three modes: enactive, iconic, and symbolic. These three modes correspond roughly with Piagetian stages of development. The enactive learner is predisposed to learning with the concrete, the iconic learner with visual stimulus, and the symbolic learner with verbal reasoning. A variety of studies have shown that students growth through these stages is sequential and largely predicated on age. Bruner suggests, though, that even students who are functioning at a predominately symbolic level benefit from exposure to new materials in all three modes. He describes a study (Bruner,

1973) that is of particular significance in this regard. The independent variable in the experiment was the mode of representation of a Piagetian conservation task. One group carried out the actual manipulation of materials themselves, one group watched the transformation and was required to verbally describe the results, one group performed both the manipulative and descriptive tasks, and a fourth group simply watched as an experimenter performed both tasks. Only the students who engaged the task at all three levels - enactive through manipulation, iconic through watching the results, and symbolically through their descriptions - showed significantly different post test results; and these results were markedly different. Bruner concludes that only by providing the children with both the opportunity to represent the problem enactively and symbolically were they able to create the necessary cognitive dissonance to overcome the appearances of the iconic mode.

There is a substantial body of Piagtian research in the area of historical understanding which relates to Bruner's conclusion. Hallam (1967) has studied the growth of historical understanding in Piagetian terms making use of evaluator ratings of student responses to historical readings. These studies conclude that formal operational levels of historical thinking are typically three to four years later in developing than in math and science. A subsequent study by Colthan (1971) supports the same conclusion. More recent work by Kennedy (1983), though, related the Piagetian model to work in cognitive psychology dealing with information processing capacity. Kennedy concludes that student information processing capacity is positively related to historical understanding and only weakly related to developmental level - suggesting that historical understanding may be less a function of development than of the capacity to process information. From this perspective the educational question becomes one of enhancing student information processing capacity, that is, enhancing student ability to manage and organize information, to question, and to store and apply existing knowledge.

A significant facet of these studies and of most instruction in history (and social studies in general) is its overwhelmingly symbolic nature. To the extent that the social studies curriculum denies students enactive and iconic means of dealing with content (Project SPAN, 1982), they are being denied opportunity to develop a more complete representation of knowledge.

Field Independence/Dependence

A learner presented with a complex source of information will tend to approach that information in one of two distinct ways: globally or analytically. The global learner tries to conceptually digest the information as a whole, unable to focus on specific factors. This style of learning reflects field dependence. On the other hand, the field independent learner recognizes and deals with specific facets of the whole - identifying patterns and discriminating between localized attributes. Field independent learning is highly correlated with success in social studies; undoubtedly this is largely due to dependence on text and lecture/recitation delivery of content. Satterly (1979) presents evidence of this relation in the area of geography. He notes, for example, that interpreting contour information from a map requires the ability to discriminate information locally. Inexperienced map readers who exhibit field independent learning behaviors are typically more successful at this endeavor than field dependent learners (Sholl and Egeth, 1982). Sholl and Egeth qualify this observation by noting that more expert map readers have the capacity not only to analyze local information such as contours, but are able to synthesize the results of their analysis at a global level, demonstrating superior visual memory. The same authors conclude that only through extensive practice will students aquire the ability to synthesize the results of analytical bits and pieces into global wholes that can be used to visualize a terrain. They are corroborated in this conclusion in a study by Underwood (1981) of student visual-spatial abilities.

Tools for Analyzing Information

Cognitive Skills for the Social Studies

The areas of study included under the guise of secondary social studies make the task of identifying a single set of cognitive skills a difficult one at best. A 1981 report by the National Council of the Social Studies suggests the following (A Report of Project SPAN, 1982):

Data Gathering Skills
  Acquire information by observation
  Locate information from a variety of sources
  Compile, organize, and evaluate information
  Extract and interpret information
  Communicate orally and in writing

Intellectual Skills
  Compare things, ideas, events, and situations
  Classify or group items in catagories
  Ask appropriate and searching questions
  Draw conclusions or inferences from evidence
  Arrive at general ideas
  Make sensible predictions from generalizations

When applied to the various subject matters these general skills may be stated more specifically. In history, for example, compiling and organizing information may involve seriation, reflecting the chronological aspect of the subject. Extracting and interpreting information in a geography class may involve the overlay of map displays to produce spatial representations of relationships. This objective in the sociology classroom may be more successfully achieved graphically or statistically. The classification of opinion in the citizenship class may invlove collection of data and logical grouping. Perhaps one of the reasons such objectives receive as little classroom attention as they do (A Report of Project Span; Wiley, 1977) is that managing the large amounts of necessary information is not only a tremendous problem for students, but for teachers as well.

Problem Solving

Problem solving is a major concern of all curriculum areas in the mid 1980's. The tradition of emphasizing problem solving in the social studies extends back at least as far as Dewey and has been referred to variously as "inquiry", or "reflective thought", or "decision making". Unfortunately, this tradition has largely been one of lip-service. This may in part reflect on the nature of problems in the social sciences. They frequently require reasoning and mathematical skills which secondary students are not trained to use. Hypothesis testing - conjecturing about a relationship between two or more groups - is, for example, conceptually within the realm of many high school students. Testing the conjecture is beyond the realm of their experience, though, in terms of the statistics required. Realistic conclusions from field or laboratory experiences or other data sources in geography, sociology, or psychology may require comparison and logical manipulation of large sets of data. Visualization of geographic relations may require preparation and variation of a series of maps and overlays to be effective. Such problems are at the heart of social studies inquiry, but because of a variety of constraints, which include a lack of student skill in areas such as statistics, graphing, and cartography, cannot realistically be attempted on a large scale.

Fey (1984) has argued that in the area of mathematics education the existence of the computer in the classroom makes possible a new sequencing of the curriculum. Students can engage material from the level of the forest first instead of the traditional tree-by-tree introduction to prerequisite skills which allows limited attention to solving significant problems. As an example, he suggests an inverted order to the algebra curriculum. Students are to be provided with computer software tools to plot and graph relations and to manipulate and solve equations. Using such tools they can devote significantly more time and practice to problem solving - to creating and analyzing mathematical models of problem situations. A similar possibility exists in the social studies.

A Role for the Computer

Having identified a variety of problems associated with learning in the social studies, it remains to clarify the role of the computer in addressing these issues. It needs to be emphasized that what follows is presented in the form of several hypothesis - the tool roles of the computer to be suggested need to be validated experimentally and proven feasible in actual classroom situations.

1) Computer generated graphics can be used to provide students with the experience of integrating analytic (field independent) and synthetic (field dependent) cognitive functions. The map reading study by Satterly (1979) is suggestive in this respect. Computer generated maps can be graphically enhanced in a dynamic fashion to emphasize specific features. Use of flashing gradations of color to draw student attention to changes in contour, superimposition of a scaling device at any point of student interest, and the ability to arbitrarily reorient the image are all examples of making use of computer graphics to first present a global image and then focus on a specific detail in a manner that may contribute to the integration of synthetic and analytic functions.

Shephard, et al. (1980) report on the use of computers in geography to represent information spatially making possible contrast with more conventional verbal, field independent representations.

2) Use of computers can put problem solving tools into the hands of students that would otherwise not be available, and in so doing allow them to gain considerable practice solving realistic problems. Shephard, et al. (1980) observe the obvious: "The best way to learn to solve problems is to be given problems that have to be solved." It may be added, "...and the tools with which to solve them." Hypothesis testing and regression analysis, for example, become exercises in computation when done by hand, exercises which cloud the reason for doing the computation in the first place. Students armed with an understanding of these activities at a conceptual level and the appropriate software, can apply these reasoning tools in a manner which may allow them to grow in their ability to solve problems. Shephard, again, (1980) cites a variety of materials being used in geography education in this capacity in Great Britain. Botein (1977) describes the potential for similar applications in history ranging from the comparative analysis of the economic growth of cities at the college level (Litchfied, 1983) to analysis of information gathered locally from tax and census lists suitable for secondary students (Pruitt, 1977). Hunter (1983) recommends the use of general purpose filing/data base programs to provide students with the tools for logical organization and analysis of information.

The materials of the High School Geography Project on local communities are another excellent resource (High School Geography Project, 1971).

3) Bruner's prescription for instruction in mixed enactive, iconic, and symbolic modes invites the use of computers as well as other media. The results of enactive local history and geography research activities, for example, analyzed through the use of iconic computer graphic software, and presented in symbolic, verbal, form would provide students with a means of synthesizing information at a level not commonly practiced. The three to four year lag in the development of formal reasoning skills in historical understanding compared to the development of similar skills in math and science may be as much a result of the almost total dependence on symbolic methods of instruction as the need for increased processing capacity suggested by Kennedy (op cit).

Conclusion

Identifying ways in which secondary social studies students and teachers can make use of the computer's rapid computational, logical, and graphical capabilities is an easy task. Many possible applications have been cited. The effectiveness of the use of these tools remains unknown, however, and in need of experimental verification. What is certain is that the use of this single new technology is not in itself an answer to the problems of the social studies classroom. Indeed, these problems may be compounded if computers are used simply for the sake of using computers. Their use should be based on the specific instructional and learning needs of the classroom and should promote, as Goodlad and others suggest, study of the human dimension of the social studies which is its ultimate appeal.

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BUSINESS COMMUNICATIONS THRU APPLEWORKS

BY BOB MOWRER

Business Communications was an experimental class offered at North Eugene High School in the spring of 1985. It was designed to improve a student's grammar skills while using the Appleworks word processing program.

Problem Definition

The existing curriculum was not meeting the needs of the vocational students, nor was it attractive to the students not planning office careers. Changes in the office and changes in our schools demanded that we rethink the curriculum. The office is being revolutionized by electronic technology. Students are moving toward a more academic course of study. The computer is becoming commonplace in the classroom. Factors that needed to be addressed in any changes were as follows:

The Problems

Decline of second year typing program. North Eugene's second year typing program was not attracting a sufficient number of students to justify offering the class.

Advanced typing not meeting vocational students needs. The second year typing program concentrated on advanced formating skills and in developing a higher level in keyboarding skills (speed and accuracy). The need for our students was not only formating and keybording, but proofreading, editing, and revising using electronic devices. If a worker must redo a business correspondence several times because he/she lacks the skills to efficiently proofread or edit; the skill of typing at 80 words per minute with no errors is not valuable to an employer. If a person could not write, proofread, and edit efficiently they were not prepared for work in the office of the 80's.

Incorporating computer technology into curriculum. Because of what was taking place in the office, there was a need to create a program that would involve the student with electronic technology as quickly as possible.

Improvement of language skills. A skill universally lacking in our graduates was the mechanical skill of writing (punctuation, capitalization, spelling, using the correct word, agreement of verb and subject, etc.). A student lacking in these skills is unable to efficiently produce usable copy.

The Research

Gayle Ragsdale, creator of the course, took a 12-week leave of absence to find out what other schools in Oregon were doing with computers/keyboarding/language skills as well as create the course. Gayle found out that there were schools doing word processing, but no school was doing a combination of language skills/word processing that was desired. Gayle found no course that used a word processor as a way of teaching as opposed to having the word processor be then object of the instruction.

The Course

Business Communications was based on Communication Skills For The Processing Of Words published by South-Western Publishing Co.; copyright 1981. The workbook had been used in our curriculum previously. The change was made in the way the materials were delivered to the student. Rather than a paper medium (workbook and paper) an electronic medium was used.

Materials

The workbook. Communication Skills For The Processing Of Words divided communications skills into 16 units: commas, semicolons, apostrophes, homonyms, numbers, quotation marks, capitalization, troublesome words, and subject/verb agreement. Each unit is divided into rules that apply to that unit. Each rule is stated, demonstrated by example, and applied through student practice. This practice consists of 3 to 5 sentences in which the student is expected to apply the rule. At the end of the unit (2 to 5 rules) the student is required to apply all rules of the unit by retyping a "Sentence Exercise." Ten sentences are provided that contain errors that the student must correct. This workbook is directed toward a business education class, so the student is directed to retype the sentence. The workbook does provide space below each sentence so a student could handwrite the sentence if the workbook were used in a class that did not emphasize typing or keyboarding. Editing assignments were provided for each unit. These letters, memos, or manuscripts checked students on current principles. Alerts "alerted" the student as to the number of usages of each principle while proofs/mastry problems provided no aid as to number or type of principles.

Disk Version. Each assignment is explained on the handout by unit name and assignment number (Assignment 1-48). The handout contains the rules, examples and practice provided in the workbook. Clear, concise directions are provided in the assignment specifications dealing with format, changes students are expected to make, how and when the assignment is to be turned in, etc.

Each unit has three documents to be edited. The first document is an "Alert" in which the student is directed to find a specified number of applications of the rules presented in the unit. In addition, students are required to apply rules learned in previous units. The second document is a "Mastery" (Proof A) in which the student is directed to apply all rules presented to this point. Both of these assignments are graded and returned to the student. Students must be able to edit the documents with no more than three errors before the unit is approved and the unit test (Proof B) is taken. If a student is unable to achieve this criteria, additional practice sentnces are assigned before the unit test is administered.

Needed Equipment

Student Disk. Each student has his or her own student disk. On the student disk are 50 assignments. Assignments are business documents that need editing. Students are expected to locate and correct errors in the letters, memos, or manuscripts. When dates are involved, the student is directed to edit the date to the current date. When the correspondence includes the name of the sender, the student is directed to edit the name to be the name of the student. No format errors have been included on the student disk in order to focus on the rules the student is studying. The student disk is an electronic version of the alert and proof of mastery exercises in the workbook.

Master Disk. The master disk is the teachers "ditto master". On this disk are all 16 units (rules, examples, and student practice). From each unit file the student handout was prepared. The handout format was used rather than using the workbook for two reasons. One, the course encouraged each student to work at his or her own pace. Having the student check out the handout provided better control of the pacing than would the workbook. Secondly, the workbook and the student disk had slightly different versions of the assignment due to format changes. It could have been confusing to the student to have two different copies of the same assignment.

Appleworks manual. Not all of the students were familiar with the Appleworks word processing program prior to starting the class. The class stressed individual rather than group instruction so there was a need for giving the student information about the Appleworks program. A short manual was prepared for the students which outline the procedures the student could be expected to use. The manual was intended to assist the student to get through a procedure she/he was not familiar with and to provide a reference manual the student could use when trouble shooting.

Apple II computers. Each student had access to a computer for the full period each day. As all assignments were one or two pages, 64 K of memory would have been sufficient. Each computer was connected to a printer thru a switch box. A printer was connected to three computers. Our course did not intend for the student to save the edited version of the assignment (their student disk was write protected). If a student did not allow sufficient time to complete the assignment, they had to redo the editing the next day. The school offered to sell students their own data disks so students could save their work; however, only one student took advantage of this. Students managed the edit/print routine and had very few problems.

Course Operation

Getting started. A brief introduction to Appleworks was given the first three days of the course. This was one of the few times in which group instruction was given. Along with the introduction to Appleworks, a pretest was given. The pretest checked the student's ability to recognize correct usage of mechanics. The students then started on their assignment handouts.

Daily routine. In each assignment, the students were expected to read and study the rules, do the practice exercises, and then move to the word processor to correct the alert exercises. The student was directed to turn in the alerts and take the unit test (proof) after their alerts had been graded and returned. If the student did not due well on the alerts, they were given a handout of the ten sentence exercises to provide review prior to taking the test.

Grading. The student had two grades for each unit, one for completing the alerts, and a score on the test.

The teacher. The teacher had the mechanical things to do—take roll, pass back papers, make sure all materials and disks are ready. Most of the teacher's time was spent in addressing student questions. Sometimes this was initiated by a student's paper which indicated a problem area, and at other times this was in response to a student question.

Observations of the Class

Focus on learning. Having the editing done thru Appleworks provided a highly on-task environment. Students stayed on task to a higher degree than when the same work was done using a typewriter or with pen and paper. A second benefit was provided by the electronic medium. Students were interested in the correct answer. It was commonplace to have an intense discussion develop on the way a particular sentence should be edited. The students would resolve the question or ask for teacher help, and make the change with the word processor. The freedom to re-edit electronically allowed the student to focus on the right answer rather than defend what they had already typed!

Fringe Benefit. Two students not only managed to get all of the assignments completed, but also did their English assignments on the word processor using class time. Students and parents commented on the value of the class to thier work in the English class.

Learning a word processor. One of our concerns was how much time it would take the student to "learn" the word processing program. The main focus of the class was on the language skills and we did not want to spend a great deal of class time learning Appleworks. If the students had zoomed through the 16 lessons, we had plans to do additional work with Appleworks; however, the students moved slower, rather than faster than anticipated. Two things are worth noting regarding the students use of Appleworks. First, since the class was limited to the editing of existing files, the students did not "learn" many of the features of the word processor. Much student experimentation went on when the student had a few minutes at the end of the period; but since the students did not really practice these features, the student knowledge of the word processor was limited. Secondly, we were surprised by how quickly the students learned how to use the parts of Appleworks they needed to complete the assignments. It appears that when the word processor is a tool the student must use to do the assignment, it causes fewer problems than when the word processor is the assignment.

Results. On the pretest, the 15 students made an average of 49 errors on 20 sentences. Since the students could miss an existing error or change a nonexistant error, there is no total possible score. The total errors on the pretest ranged from a low of 39 to a high of 60. The average on the posttest was 25 errors. The range was a low of 4 to a high of 45. The average improvement was 24.1 errors.

The Future

Reflecting upon this first time effort, two conclusions were reached. The students did a better job of improving their language skills when using the word processor than when using a typewriter or pen/paper. Secondly, we now believe that the student should learn while using a word processor rather than learning about the word processor. The electronic device should be a tool for learning, not the end product of learning.

North Eugene would like to expand this class to a full year program. The first trimester would be the editing/grammar that we now do.

Formatting. Next, we would focus on formatting. The formatting would be done in same manner as the grammar unit. The student would be given unarranged copy (from the disk) with format errors as well as grammar errors. By providing the student with copy from the disk, the student is able to make many more format decisions than if the student had to key in each assignment. Each unit would also require the student to key in an assignment from unarranged copy. The formatting course would also involve the student with preparing reports from an Appleworks data base and spread sheet. In order to complete the format assignments, the student would have to use many more of the wordprocessor's features that they used in the first term. As was done in the grammar part, the word processor is taught as a tool for completing the coursework rather than as a end product.

Composition. The last trimester would involve the student in authoring business communications on the word processor. In addition to grammar and format; style, clarity, and other composition skills would be focused on.

COMPUTERS IN THE BUSINESS CURRICULUM--A LAUGH EVERY NANOSECOND

Helen and Casey Fast

Preface for readers

We wrote this paper for a live audience, for active participation, improvisation, spontaneity, and not for a written medium. Reducing it to typed pages that convey our visual and audio nuances was difficult. But, we offer no apologies because, we believe our text gives you the flavor of what we see, feel, hear, touch, and taste in teaching computers.

Introduction

This presentation is about vaudeville, the universe, chickens, nudity, English, Zen, and of course, computers. Where would you like to begin? You each have a stick-on dot; come to the front of the auditorium and put it on the topic you prefer. Hurry, technology cannot wait.

Now that you have told us what you want, we remind you that in the working world, the boss controls. In the classroom, the teacher is sovereign. In the army, the general takes command. And for the next 45 minutes, we, your speakers, are in charge. We'll begin where we want to begin; we have planned to start by describing our audience response techniques, as follows.

We will have question, answer, and discussion time at the close of our talk, but we welcome your comments at any time. If you want to say something, wave the American flag you've been given. We'll pause, hear you out, and let the group interact.

Why wave flags for simple questions? Because we respect the flag; we never ignore it. Questions are as sacred to learning as the flag is to our country. You should be proud to ask them, especially if you ask about an unclear point in our presentation. Everyone learns best by making mistakes and asking questions. Let's have 5 seconds of flag waving to get warmed up.

The Universe

Spreadsheets are "universal" in the world of microcomputers. VisiCalc was released in 1977. It generated many successors: SuperCalc, MultiPlan, Lotus 1-2-3, AppleWorks, etc. These account for 90% of all non-wordprocessing microcomputer applications.

AppleWorks claims to be the best selling software package in the universe; however, it's manufacturer cannot verify where or how many copies have sold. Computer marketing publications acknowledge Lotus 1-2-3 as the best selling software since January, 1983. Who's the leader is beside the point. The fact is that spreadsheets are the benchmark in computer applications. They are the software everyone should start with. Let's look at 35mm slides of specific spreadsheet uses.

Grade book on AppleWorks. You can build a grade book on AppleWorks by putting student names in the first column, allowing columns for attendance, homework, quizzes, and tests, building weighted average formulas in a column on the right, computing each student's class rank, and finally using IF or LOOKUP formulas to calculate GPAs. You will have to type in the names, attendance, and scores. The spreadsheet handles all calculations. With practice, you can create a sheet for thirty students in 5-10 minutes.

Spreadsheet printouts are fast too. You can print all students a copy of your grade book, so they can compare their preformances--of course, you'll need to remove student names before printing. With the entire grade book, students and parents know more about their standing than when they get single letter grades.

Inventory depreciation table on AppleWorks. Our business clients keep inventory depreciation tables for tax purposes. When an inventory item ages to the point where its value is $0, it no longer contributes to tax write-off and is ready for trade-in.

Our depreciation table displays the current date. It has columns for inventory names, inventory numbers, date of purchase, cost of purchase, and life expectancy. In the last two columns are formulas to compute the age and current value of each item. The spreadsheet rows can be arranged to identify items with $0 value.

Expense journal on Lotus 1-2-3. Lotus is powerful enough to run fully integrated accounting packages like CPA+ and Ready-to-Run-Accounting. You can build simpler packages yourself with 12 hours of training. Our expense journal has one range with columns for check #, date, payee, description, amount, and account numbers. A second range has account numbers, account names, and formulas for cumulative expenses. The latter are built with Lotus's data statistical functions. When using our expense journal, you'll have to type in the expense details; the computer will calculate all cumulative expenses for you.

Payroll on Symphony. Symphony is an enhanced, improved version of Lotus 1-2-3, that contains spreadsheets, data bases, and graphics, plus, word processing, special data forms, and telecommunications. Symphony is difficult to learn without formal instruction, but with 12 hours training beyond Lotus, you can create applications equivalent to some costing $8,000 to $12,000.

Our example payroll has a menu so the user makes an initial choice between "Monthly reports," "Payroll," and "Setup." The monthly reports option provides payroll checkstubs and company quarterly tax reports. Payroll is the monthly process for recording hours worked. Setup is used for entering new employees into the payroll system.

Once each month, the user selects "Payroll" from the menu and enters employee hours and bonuses. LOOKUP formulas automatically compute federal taxes, state taxes, social security, FICA, etc., and the "Report" option prints the checkstubs.

Wild Plum Restaurants, Specialty Forest Products, our company, and others are using this simple payroll model. It works for 200-300 employees.

More On The Universe

When you give computer training in a business or classroom, the most important fact you should remember is that you are dealing with people. Who are they? What describes them? How do they behave? What are their likes and dislikes? Answer these questions, and you will have a foundation for providing practical computer training.

In your packet, find an activity titled, "Client Descriptors." Work with at least two people to complete this activity as soon as possible. (Remember, technology will not wait.)

Here's how *we* would do the exercise.

* * * * * * * * * * *

Client Descriptors
Business People Vs. High School Students

Check whether the words on the left describe a business person or a high school student (only one check per item). At the bottom add three or more words of your own. Work with at least two people in completing this exercise.

		Business	Hi School
1.	Immature		x
2.	Uninhibited		x
3.	Individualist	x	
4.	Wise, jaded	x	
5.	Intimidated	x	
6.	Prone to cheat		x
7.	Unmotivated		x
8.	Methodical	x	
9.	Fear games	x	
10.	Superficial		x
11.	Loves games		x
12.	Motivated	x	

Our descriptors often apply to both business clients and school students; our exercise requires you to make choices. This illustrates a common occurrence in our universe--our lives consist of choices. It reminds us that our clients and students are learning from us because of choices. Some have been forced to study computers, which explains why they are intimidated, jaded, superficial, or unmotivated. Some choose to live in an alien universe of MTV, designer jeans, and clove cigarettes. Small wonder, we cannot relate to them. Yet, as trainers, we are obligated to understand their universe and make their (not our) training relevant, which leads us to our next topic.

Chickens

Mary (not her real name) works in the personnel department of a multinational corporation. She is 53 years old, and she has been sent to computer training. She has learned spreadsheet concepts slowly and now faces the copy routine for words, numbers, and formulas. We'll role play the situation. Helen plays the role of Mary, Casey plays the instructor, and here's what happens.

Instructor: To begin the copy command, you hit the slash key and C. Second, you hit the Return key. And third, you type in the target range.

Now, use this supplies list program; copy the cost formula down its column.

Mary: (Looks very hard at the computer monitor. Says nothing.)

Instructor: Well, go ahead. Put a formula in the cost column so you can copy it.

Mary: (Nervously shuffles paper handouts. Does nothing on the computer.)

Instructor: (Rocks back and forth on heels. Acts bored.) Move the cursor to the top of the cost column and enter the formula.

Mary: (Moves the cursor, enters no formula. Appears very embarrassed.)

Instructor: Enter the formula so you can copy it.

Mary: (Tears in her voice.) I don't know what the formula is.

This drama continues; you can guess its ending. Mary is intimidated by the computer keyboard, she doesn't know what "enter" means, and she has no understanding of simple formulas or math. She is prevented from ever beginning to comprehend the copy routine because she has no foundation to build on. Mary is afraid; she is chicken. But, the instructor is the biggest cluck of all.

The instructor teaches by rote. He says, "Slash and C" without reminding Mary what slash does--it brings up the command menu where she will see the word "copy," and the C key activates the copy command. He says "enter" when "type-in" would make more sense.

The instructor fails to explain that the computer requires a formula first and must know where the formula is, before it can copy it, which is what the "Return" key is all about. He gives no positive reinforcement. He doesn't call Mary by name. He provides no examples. He lacks the good sense to guess that Mary has forgotten simple algebra. He is teaching like a robot rather than a real, live, breathing person from this universe. Our instructor needs to begin at Mary's level. He needs to "strip away" jargon, words like slash and C, enter, target range, and cost formula. And "strip away" leads us to the next topic.

Nudity

Computer concepts are best learned if they are explained in everyday terms, without special words: bits, bytes, ROM, RAM, CPU, nanosecond, DOS, bootup, file architecture. Granted, computer users must learn logic, vocabulary, and syntax eventually. However, clients like Mary learn better from familiar experiences. For example, she could be asked what she would do if she wanted five copies of a photograph. She would understand the need for providing an original of the picture, and she knows she would give explicit orders about where to send the five reprints. Stripped of jargon, copying a formula on a spreadsheet works the same way.

English

Sadly enough, Mary could not build a cost formula. She did not know simple algebra, or English grammar either. Regarding grammar, Richard Mitchell says:

> "As it happens, computers work by reading and devising grammatical sentences in orderly sequence. The 'language' is different, but that's how they work. Their 'rules' are far more stringent and unforgiving than the rules of discursive prose. When we read a sentence whose subject and verb don't agree, we don't reject it as meaningless and useless. We shake our heads and sigh a little, but we know what the poor fellow meant, and we go on. When the computer 'reads' a 'sentence' with an equivalent error, it simply spits it out and refuses to work. That's how we can tell which are the machines and which the people; the people will swallow anything."

So, while teaching computers, we end up teaching universal concepts: English, algebra, keyboarding, and spelling. At the same time, we must abandon our own rigid universe of formal education and present lessons from the perception of our clients. Otherwise, they will not hear us. Only in Zen philosophy are contradictions like this tolerated.

The HOPE Approach to Computers

Last year a University of Oregon graduate student did a practicum class with our company to find out what background was needed for successful computer consulting. At the end of the term, we asked him what he had learned. He said to be a consultant, you need to know more about everything than anybody else. He's right. A good computer teacher needs to know computers, a multitude of software, and a whole universe of applications. To simplify this, we have designed the three-step HOPE approach to computer training:

1. HO stands for Hands-On. No one can learn computers (or most other things) effectively from lectures. Classes with 2 or 3 computers for thirty students are a joke. In our training, we guarantee that three of every four learning hours will be spent one-to-one, on the computer.

2. P is for Practical. Training should be based upon the students' experience and understanding. It must be applied to things they already know and are interested in.

   P could also stand for practice. For example, we've discovered that after clients understand the concepts behind the copy command, they benefit from chanting aloud, "Slash, C, Return." This practice turns concepts into routines just like running scales on a piano habitualizes skills needed for fugues.

3. E means Expand. Take your students and clients beyond their experiences to brand new experiences. Computers really can "extend the mind," but only when good trainers help in the process of expansion.

Throughout our presentation we have practiced the HOPE approach. You've been an active, hands-on audience, rather than passive. We have shown you several practical examples of computers in business education. We've tried to get you to expand the universe of your computer experience. We've given you ridiculous prompting words to help you remember our major topics. We've demonstrated that speeches about computers can be fun. We apologize for not discussing vaudeville, one of the topics promised at the beginning. To correct that oversight, we'll close with a song about the universe and eat 8088 chip cookies.

"Just remember that you're standing on a planet that's evolving
And revolving at 900 miles an hour.

"It's orbiting at 90 miles a second, so it's reckoned,
Around the sun that is the source of all our power.

"The sun and you and me, and all the stars that you can see
Are moving in a million miles a day

"In an outer spiraling arm, at 40 thousand miles an hour
In the galaxy we call the Milky Way... "

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The Presentors

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MICROCOMPUTERS IN THE ART CLASS

Dr. Linda Ettinger

Introduction

Art curricula often focus on design knowledge and development of technical skills. Curricula also focus on historical and cultural knowledge and development of critical skills. This paper examines how the microcomputer can be introduced into the art curriculum in each of these general areas of study.

The suggested areas of study are designed to utilize existing microcomputer software, although mention of particular software packages is not necessarily an endorsement. It should be understood that microcomputer software is available in various levels of technical complexity, and can be used in a variety of ways. Art teachers need to determine if a particular software package will be useful and appropriate in their class in regard to: (1) the general curricular philosophy; (2) the particular class audience; and (3) the particular teaching goal at hand. For reviews of microcomputer graphics software commercially available see Schwartz (1985); Arrants (1984); Bonner (1984); Hanlon and Roland (1983).

Focus is on the investigation of the microcomputer as a visual medium within an educational context. Use of the microcomputer for classroom management and research will not be covered in this paper. For information on these applications, refer to DiBlasio (1983); Hubbard and Linehan (1983); Madja (1983); Ettinger and Rayala (1980); and Jones (1980).

There are no distinct dividing lines between the following suggested areas of study. An art teacher may, in fact, combine a number of ideas when developing the content to be presented in a particular sequence. Also, while no grade level distinctions have been suggested, it is recognized that some of the activities may be more appropriate for students in the upper grades, at advanced levels, or perhaps only for a specific group of art students who have expressed an interest in art and computers. No attention has been given to the problem of sequencing these experiences. A teacher must carefully analyze a particular group of students and the particular school setting before developing a computer curriculum. In addition, some of these activities can be incorporated in traditional art programs, regardless of the actual presence of microcomputers as an art medium.

Two-Dimensional and Three-Dimensional Microcomputer Images

A microcomputer can be used as a visual art medium in a variety of ways that simulate current studio activities. The following points examine ways that can be related to many existing art processes.

The computer screen is a two-dimensional display device where students may electronically mimic some of the actual procedures of drawing or painting on a flat surface. Using graphics peripherals and software, such as the Koala Pad with the Micro-Illustrator Program, art teachers may plan computer experiences similar to those involving traditional two-dimensional media. Art teachers must ask, however, if a particular program will help teach something already taught in a better way.

Microcomputer paint programs such as The Complete Graphics System or Dazzle Draw provide the opportunity for students to produce images on the screen selecting from a range of possible brush types, shapes, lines, rays, points, along with various fill patterns and graphic techniques modeled from existing techniques in other media. The number of colors available depends on the microcomputer system and software used. Color is not yet available on the Apple Macintosh, although a sophisticated draw-and-paint program can be purchased. Microcomputer draw-and-paint programs enable students to see more variations of a design or image faster than is possible using cut-and-paste or tempera paint methods. From an instructional point of view, more is sometimes better, such as when a comparative judgment must be made.

Students may also use the microcomputer to draw three-dimensional figures on the computer screen. These figures differ from two-dimensional shapes in that they must be modelled mathematically using a Cartesian coordinate system defined by X, Y and Z coordinates. Objects may be drawn with the aid of a 3-D graphics software package such as Apple World or by writing a program. Once stored in the microcomputer's memory, a three-dimensional figure can be moved around in space and rotated on an axis. An important Master's Degree Thesis has been written on this subject by Sachter (1984) entitled, The Basic Concepts of the Three-Dimensional Computer Graphics for Artists. Although Sachter does not solely present information related to microcomputers, the thesis is specifically written for use by artists. As such, it de-mystifies much of the computer-science jargon concerning graphics and is an excellent resource for art teachers.

The process of three-dimensional image construction and rotation is perhaps one of the most visually exciting problems a student can address via the microcomputer. For more information on this topic see Harris (1984); Myers (1982) and Truckenbrod (1981).

Microcomputers and Basic Design

Students may be asked to solve compositional problems either by using readily available software and peripherals or by programming the computer to produce visual solutions. With the software program PatternMaker, elementary school students may explore principles of balance, positive and negative space, color, depth, and motion while creating visual patterns on the computer screen.

If developing programming skills is deemed a desirable outcome of computer-art instruction, students may be asked to solve problems such as, "Create a linear composition indicating space nonobjectively, using the high-resolution graphic commands available in BASIC."

Microcomputer graphic systems have significant potential for design instruction as "idea processors," enabling students to generate a large number of different solutions to a given visual problem in a short period of time. Such systems allow students to determine the best solution in terms of a specific set of criteria, opening the way for discussion regarding comparison of contexts and the need for different designs for different purposes.

Students may also be asked to view and discuss examples of computer imagery created by themselves and others in terms of the elements and principles of design. The visual qualities manipulated by computer artists are similar to those of other artists, including color, light, form, texture, and space. While there are some visual qualities unique to computer images, it is valuable for students to examine computer images in ways similar to viewing images created in other media. Once the analytical process is begun, the unique visual qualities of these images will be discovered and then can be exploited within the art context.

The Microcomputer as an Art Medium

The microcomputer can simulate existing art media as shown above, but it can also function as a new, separate medium. Students can learn about microcomputers in the same way they learn about other art media and processes in the typical school art program. Technical aspects of this medium can serve as a basis for lectures, audio-visual presentations, research projects, or hands-on experiences with computers. Possible topics of study in this area might include:

1. different ways for inputing an image into a microcomputer and the different visual qualities attainable with each;
2. various components of microcomputer graphics systems and the functions of these components;
3. use of the computer to control other pieces of equipment in the production of art objects. (Jones, B. Microcomputer-controlled generation of artifacts as an interdisciplinary teaching aid. TCT, 10,5,1982. 42-45.)

Microcomputers need not, and should not, reduce the variety of media employed in the art room. Furthermore, microcomputers may be used less to substitute for other media than to provide experiences that can't be achieved in other ways. The following is a list of study areas designed to help students gain insight into the unique aesthetic potential of the microcomputer as an art medium:

1. Interactive Art. Ask students to write a program which requires the user to become actively involved with the image displayed on the computer screen. For example, the user may be asked to input values through the keyboard or manipulate a simple graphics tablet which will determine the colors or shapes in the image.

2. Pattern Generation. Ask students to write a program which builds a pattern based upon a single shape or motif. Truckenbrod (1982a, 1982b) illustrates ways shapes can be transformed and mirrored as they move through a pattern. An alternative method to exploring pattern making with students is with the software program PatternMaker, mentioned earlier, which is easy to use and offers a number of options.

3. Real-time Animation. Ask students to write a program which introduces the elements of time and motion to the work. Simple animated effects are achieved with programs that in essence draw a figure, erase it, and then redraw it a sort distance away on the screen. Attempting sophisticated animation directly from BASIC or machine language is a difficult and time-consuming task. Thus, teachers may wish to have their students explore the potential of animated graphics with software packages such as The Graphics Magician or Movie Maker or Mr. Pixel's Cartoon Kit which dispel some of the tedium involved in programming animation.

4. Sound Integration. Ask students to write a program which incorporates sound in their work. The elements of shape, color, and movement may also be linked to use of sound. In this area, the program PictureWriter includes a music mode that will play a note for each shape drawn in a picture. The higher the shape is on the screen, the higher the note.

5. Random Images. Ask students to write a program which introduces the element of randomness to determine specific variations of the image being displayed on the computer screen. Helmick (1984) discusses the role of randomness in human creativity and illustrates ways the computer can be used to generate random events which in turn control specific aspects in a work of art.

6. Artifact Construction. Ask students to design personalized objects and execute them using microcomputer-controlled tools, also developed by the students. Jones (1982) shows how the microcomputer can be used in the creation of three-dimensional artifacts as a part of interdisciplinary learning.

Computer Graphic Imagery in Our Society

As the microcomputer is used as a visual art medium more and more, issues concerning aesthetics, criticism, and sociocultural aspects of microcomputer art must also be addressed in the art class. The rest of this paper examines ways to understand and analyze microcomputer art in our visual environment.

Teachers quickly realize students are already familiar with many applications of computer imagery in our society. For example, they see such imagery in the form of electronic games, movies and television advertising. Art teachers can plan experiences designed to broaden students' awareness of the uses and impact of computer imagery in our visual environment including advertising, interior design, industrial design, architecture, commercial art, medical technology, science, land-use planning, astronomy, and the fine arts. Deken (1983) presents a comprehensive review of current uses of computer imagery in various visual contexts.

Visual resource material is available which may be used to illustrate advanced applications of computer graphics technology in art and other contexts. The computer graphics organization, SIGGRAPH, has slide sets and video cassettes for purchase which include much of this kind of imagery. Current computer magazines are also an excellent source of imagery. Students may be asked to document, through the use of photography and on-site research, the uses and impact of computer graphic imagery in their society.

The History of Computers in Art

Because it is a relatively new art medium, computer art lacks the historical documentation enjoyed by other fine-art media. However, computers were being used as early as 1964 to create imagery that was primarily aesthetic in nature (Davis, 1973; Peterson, 1983).

The technology of computers has advanced at such a rapid rate that there is indeed a history of the use of computers in art. Many artists are using computers to produce two-dimensional still images and animation. Other artists are exploring computer use in such areas as weaving, sculpture, and performance art (Leavitt, 1976). An art teacher interested in this study may find examples of work by computer-using artists in contemporary art publications or computer magazines (Peterson, 1984; Tazelaar, 1984). Reproductions and slides can also be used. A slide/tape presentation on the history of computer graphics called Computer Art has been organized by Dr. Beverly Jones and is available on loan from the Portland State University Film Library, Portland, Oregon 97207.

In addition, the history of computer art may be approached in the broader context of the history of technology and art. Students can research links between science, technology and art that have occurred over the centuries and present their findings to the class. In this way, students will come to see the computer as one of many technological developments used and advanced by artists throughout history (see Wilder, 1983, for an extensive time-line review of technological advances in eight major visual arts forms).

Criticism of Computer Art Imagery

Art criticism can also serve as a basis for planning computer experiences in the art class. For example, criticism can center upon aspects of computer imagery including:

1. The technical merits of the image and its generating program.
2. The formal qualities of the image (i.e., design and composition).
3. The aesthetic merits of the image (i.e., its expressive significance and how well it engages the viewer).

Students can compare images created with a computer with those created with other art media to identify similarities and differences between them.

Conclusion

The purpose of this paper has been to present an overview of ways in which the microcomputer may be incorporated into existing comprehensive art curricula. Focus has been on the investigation of the microcomputer as a visual medium within an educational context.

Two general areas of study were examined: (1) use of the microcomputer as part of studio art activities; and (2) the study of microcomputer art in our visual environment. Throughout the article, software packages and literary references were presented to provide art teachers with further avenues of study.

Above all, teachers have been encouraged to incorporate microcomputers in a manner reflecting the essential knowledge, skills, and attitudes associated with the discipline.

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THE ART OF COMPUTER ART

C. MICHAEL JONES

What Is Computer Art?

A controversy: Is computer art really "art"? Knowledgeable and not so knowledgeable people are debating whether the images produced on computers can truly be termed "art" or whether they are, in fact, simply mechanical pictures belonging to an entirely other realm. I would like to offer my opinion on this subject and, further, to define art as it may apply to any medium.

First, however, I would like to clarify the distinction between "art" and "graphics." Computer graphics is a general term applied to any non-text image. It includes business graphics such as graphs and charts as well as artistic creations. Computer art is somewhat more specific in that it covers those images which are usually created for their aesthetic appeal, either for specific uses (for example: title pages & educational illustrations) or simply as non-utilitarian decorative illustrations (for example: single images, animations and "slide shows"). In this article I will use these terms interchangeably.

My definition of art is quite simple: art is "the execution of imagination." I admit that this seems to be a gross generalization, but in my experience all other definitions and explanations are either too restrictive or exclusive. Art, I feel, is the production of an image, an object, or an idea in more-or-less tangible form that expresses an inner vision; a picture from within one's mind. Often that picture develops as the work develops, and it is not complete, not truly art, until the creator "signs his name" to it, until he has completed the image in his mind. As esoteric as this sounds I think that there is a difference between "art" and "art-in-process."

Computer art, then, is the production of more or less original images using a computer. The tangible outcome may be on the screen, either as a single image or as an animation (multiple, sequential images), or printed to paper, or it may be further manipulated into another medium -- a painting or silkscreen for example. It is art because the "artist" is producing an image unique to the history of all other images. Whether he produces "good" or "bad" art is another question that I will not deal with here; I am not sure that I want to deal with that one at all!

Who Can Make Computer Art?

This question, more properly, should be "Who can make art?" Since art, as I have defined it, is more-or-less a universal, the method of art production depends upon the tools. A painter uses brushes, paint and canvas to produce a painting. If he used a palette knife rather than a brush his art would look different; not necessarily better or worse, but different. The computer, any other hardware (e.g.: a graphics tablet) and the software are simply other tools. The image produced depends upon each tool and how it is used.

The question, then, becomes "who can learn to use the tools of the computer to produce at least some semblance of art?" The answer is -- virtually anyone. Most people can learn to use a hammer adequately to drive nails. Like anything else it takes some practice to drive nails consistently well, and most people would be content with that; they have little desire or need to extend the effort to become professional nail-drivers. This analogy extends to computer art. Anyone can learn to manipulate a microcomputer, a mouse or joystick and any of an ever-increasing number of graphics programs. How well they manipulate these tools is dependent upon their experience, imagination, practice, outside help (a graphics teacher or knowledgeable friend) and, to some degree, innate talent. (I have strong reservations about the requirement of "innate talent" to produce quality art.)

In my experience of teaching computer art classes at both the high school and the college levels, I have found that all students, whether an "art type" of individual or not, can produce pleasing and creative images. There are differences. The amount of time spent with a specific program or peripheral, the amount of interest in "doing well," the prior experience in visual thinking -- all have significance. Virtually all of my students have been pleased with, even amazed by, the results of their efforts. Though few of them would profess to be "artists" they have all changed their views about their abilities in the production of computer art.

Getting Involved in Computer Art

If at some point you want to try your hand at computer art, you will first be faced with a task so frustrating you might give up before you begin. "Which software should I start with?" "Do I need additional hardware?" "What do I do if I get stuck?" The questions seem endless; the apprehension is understandable. I would like to offer some suggestions.

* If possible take a class in computer graphics production. There is an increasing number being offered as interest grows and as graphics hardware and software become more available and more "friendly."

* Find someone in your area who is knowledgeable about computer graphics and willing to share his knowledge and help. Ask for suggestions on hardware and and software and, if possible, try some before buying. (You might try this with computer stores but be forewarned: there are few salesmen knowledgeable about computer art. It is, after all, a relatively new use for computers and, like you, they can't be expected to know everything.)

* Read computer magazines. Virtually every magazine has at least one article each month on computer graphics. Type in their programs and play; you learn by doing. Some Particularly useful magazines for Apple users are InCider, Creative Computing and A+. Back issues of Softalk (no longer publishing) are especially valuable.

* Get a book on computer graphics or computer art. There are many available at larger bookstores. For a computer graphics novice interested in Apple graphics programming and how graphics work, I suggest Apple Graphics Activities Handbook by Bailey and Kerlin, published by Robert J. Brady Co. (Prentice-Hall, 1984).

Computer Graphics in Education

What is the place of computer art and graphics in education? Where do we currently see it and, more important, how can we as educators teach aesthetics and image-making to our students?

Although computer graphics is in its infancy, we see it in a great many of the commercial and public domain programs currently available. Some have an artistic title page; some incorporate graphs or charts into their presentations or user operations; others rely a great deal on artistic images to supplement the user's operation of the program and to keep his interest as he progresses through it. Certainly the most pervasive use of artistic graphics is in the many computer games available. Microcomputer games are slowly becoming more sophisticated, but the arcade games are staying far ahead in their sophistication of images and operating systems. At this writing, state-of-the-art arcade games include multiple screens, realistically simulated three-dimensions, audio response and prompting, and multiple scenarios using video disks. The near-future may offer mind-boggling options of user speech-control, multiple touch-control screens, whole-body-control (you sit in a movable sensor-couch), and thought-control (a la "Firefox"). Micros are a step or two behind the arcades; but only a step or two.

So, how do we teach the future computer wizards? Realize that we are not trying to teach them to become wizards but rather how to use the computer to create graphics and something about aesthetics. Some will become wizards on their own.

We can teach them structured programming in BASIC or Pascal or whatever. We can add a graphics unit to our computer programming course. We can loan them books on assembly language and three-dimensional algorithms. We can turn them loose with a graphics pad, a mouse, a speech synthesizer, a video digitizer or whatever we can find. We can find another teacher or a knowledgeable computer artist to teach us enough to allow us to put together a unit or semester course on computer graphics. Above all, we need to have faith in the kids. If we do nothing more than give them the use of a computer, some of them will go beyond all expectations and amaze us.

As I write this (Spring of 1985), I am reminded of a computer graphics conference I went to two years ago. I saw computers reconstruct a human face deformed at birth, a face that never was, into a face that was supposed to be; a fly-through of a DNA molecule and non-existing drugs created to interact with that DNA to prevent birth defects, correct deformities and eliminate sufferings from arthritis to hayfever; a fly-by of the planets Jupiter and Saturn with detail no man has seen first-hand...yet. I saw running shoes designed from the foot up, a city designed from scratch, a ballet dancer's technique critiqued and her dance choreographed. All of these amazing accomplishments were done on a computer by individuals who were not computer programmers, but specialists in their particular fields who found that the computer allowed them a view into and a control of their own special worlds. Although these accomplishments were done on mini and mainframe computers, the advancement of micros -- those very same computers that are sitting in our classrooms right now -- will allow new and exciting advances in the near future. Our job is to give the users, the prospective pioneers, a nudge.

The job of "giving the nudge" is not as formidable as it may seem. Several of my adult students, some with prior computer experience and some with none, have instilled the desire in their students to forge ahead into computer graphics and create some amazing images. These students may become the computer wizards of tomorrow.

The "art" of computer art, as in all other forms of art, is a process of experimentation with available tools in an attempt to produce creative and imaginative images. Quality and originality grow with increased practice. Although few of us will become computer artists, we are all capable of creating respectable images using the computer. Some of these images will make the effort worthwhile.

THE LASER DISC IN MUSIC AND ART

Phil Kessinger

The laser disc in music and art is a natural. Video resolution and sound reproduction with videodisc technology is excellent. In the 1985 annual videodisc catalog produced by Pioneer there are 150 titles that are primarily music. However in terms of commercial videodiscs on art, i.e. art of painting, there are only two in this catalog. Outside of commercial sources there are useful videodiscs in music and art. Further, even with the few videodiscs available, it is possible with a computer to expand the use of a videodisc in infinite directions for instruction and learning. And, one can produce a stereo videodisc for $300.

Commercial Videodiscs In Music

Pioneer Video, Inc. has been responsible for not only producing and distributing the likes of Eurythmics-Sweet Dreams or The Last Waltz but also a significant collection of opera and classical music such as Verdi's Ernani or Dvorak's, Symphony No. 9 ("From The New World"). The Dvorak symphony is a standard play CAV (Constant Angular Velocity) videodisc that one can use all of the functions of videodisc controls such as still or frame search. However most of the commercially produced music videodiscs are extended play CLV (constant linear velocity) with an hour of music on one side. With these CLV discs one can usually search to a predetermined point on a disc called a Chapter where there is a new piece of music. With newer videodisc players and CLV discs one can search to whole units of minutes that are encoded on the disc. Further Pioneer is now recording soundtracks in digital form on videodiscs that play on newer players.

The standard size commercial videodisc has been 12 inches, played an hour, and costs $25-35. Currently 8 inch music videodiscs are produced with popular artists such as Kim Carnes, play about 15 minutes, and cost $11.

There is a unique category of music on videodiscs that I would call Japanese "pop rock". One such disc is White Music which is a stunning visualization of all types of snow skiing. One side of this disc is free style, e.g. acrobatic, that is fun to watch and listen. Another disc in this "pop rock" category is Masayoshi Takanaka, Rainbow Goblins Story. The featured artist plays an electronic guitar in concert while a Japanese folk tale of rainbow goblins is visually portrayed. Students watching these videodiscs have found them intriguing.

Music Videodiscs Designed For Education

A well known set of films for music educators is called the Music Is series. See Appendix. These films have been reproduced on five CAV discs (10 programs) by the federal government. Topics in this music series include conducting, form, style, tone color, melody, rhythm, and harmony. In a classroom with a remote control to a videodisc player a teacher could stop the music at any point, repeat a musical phrase several times, or search to certain sections a music class was working on. A middle school music teacher commented that he had seen this music series on film and videotape and in hearing the same presentation on videodisc he heard music he did not hear previously.

The University of Delaware is producing a series of videodiscs for music educators. See Appendix. This series incorporates a visual image of various kinds of musical scores while the music is played. The ability to distinctly see what you hear and be able to control it in multiple strategies will be valuable.

With both of these videodisc series a music instructor would likely use it in a large group situation. However it would be possible to design an interactive computer controlled program of music education with these videodiscs for a whole class or a small group.

Vincent Van Gogh

One of the finest videodiscs ever made for educators to use is Vincent Van Gogh-A Portrait In Two Parts. One side of this videodisc contains the following chapters:

Chapter 1. Overview, Dutch Period.
Chapter 2. Catalog: Major Works of Dutch Period.

Chapter 3. Overview, Paris Period.
Chapter 4. Catalog: Major Works of Paris Period.
Chapter 5. Overview, Arles Period.
Chapter 6. Catalog: Major Works of Arles Period.
Chapter 7. Overview, Saint Remy Period.
Chapter 8. Catalog: Major Works of Saint Remy Period.
Chapter 9. Overview, Auvers Period.
Chapter 10. Catalog: Major Works of Auver Period.
Chapter 11. Painting Techniques: Reference Series.
Chapter 12. Brabant in Vincent's Time: Reference Series.
Chapter 13. Paris and Impressionism: Reference Series.
Chapter 14. Provence: The Land and People: Reference Series.
Chapter 15. Auvers, the Artists' Village: Reference Series.
Chapter 16. Summary: Five Major Themes in the Oeuvre of Vincent Van Gogh.
Chapter 17. Credits.

Each overview chapter of this disc has Leonard Nimoy as host walking through the places where Van Gogh created his art. Within these chapters is period music that parallels the visual art. With the dual sound tracks on this disc one can listen to Nimoy's narration with a music background, or one can switch to the second sound track and hear a different narrator, with music, reading excerpts from Van Gogh's letters for the period of art being considered. Following each overview chapter every work that Van Gogh completed in the period is presented as a series of still photographs with appropriate identification for art historians. Following overview chapters are reference chapters where one can study a glossary of terms and related painters. Included with this discs is a complete printed index of all art with frame numbers specified for quick location.

On side two of Vincent Van Gogh is a one-man multimedia show written and directed by Leonard Nimoy. This presentation is based on the play Van Gogh by Phillip Stevens where Nimoy acts the role of Vincent's brother Theo reflecting on the life of Van Gogh.

This videodisc is a combination of CAV and CLV formats. The play is presented in CLV and lasts an hour whereas the art history side of the disc is CAV and can be used for multiple hours with an interactive design. Such design could be with a remote control pad or computer.

The National Gallery of Art, Washington, D.C.

A videodisc that lends itself to interactive programming with a computer is called The National Gallery Of Art. On one side of this disc is a 22 minute video presentation on the history of the National Gallery. On the other side is a 27 minute tour through the National Gallery today. In addition to the tour a still photographic image of every piece of art in the National Gallery has been reproduced with a companion still image identifying the previous frame.

Using an Apple IIe, Allen VMI interface, and Pioneer VP-1000 videodisc player I have written a simple program in BASIC that allows one to explore the National Gallery of Art from a series of menus. This disc is a good selection for interactive programming with a choice of video or stills for instructional design.

Writing a computer program in BASIC took a fair amount of time. With a flexible authoring system that translates computer language into everyday English it would be quite easy to design a number of applications for this disc in different curriculum areas.

DRAW Technology: Make Your Own Disc

It has often been commented that the one drawback to videodiscs is that you cannot record one yourself. This is becoming less true everyday. At present one can send a 3/4 videotape with stereo sound or dual independent audio to two companies in the United States and make one videodisc for $300. See Appendix. The technology that does this is called DRAW (Direct Read After Write) and is being used in the entertainment industry for electronic editing of daily video production. It may be possible that these companies will accept 1/2 inch VHS tape to produce a DRAW disc however the resolution quality would be inferior to videotape. These DRAW discs, though inexpensive, do not have the image resolution of normal videodiscs even when premastered with 3/4 videotape. However if one wanted to make a practice videodisc, i.e. check disc, then this technology holds great promise.

Conclusion

Videodiscs seem to be made for music. With the advent of digital audio on videodiscs the power of this technology in music education is apparent. Though a significant collection of commercially produced videodiscs with music as the central focus exists, most are in CLV format and do not lend to interactive programming for instruction and learning. Paradoxically there are very few videodiscs in art and two mentioned here are perfect for interactive programming in education. Beyond buying videodiscs in music and art it is easy enough to begin making your own videodiscs with DRAW technology.

Appendix

Commercial Videodiscs (Art and Music)

Hi Tech Video Systems
12266 S.W. Scholls Ferry Road
Tigard, Oregon 97223

Video Audio Systems
2911 West 11th Avenue
Eugene, Oregon 97402

Music Is (Series)

Great Plains National Library
PO Box 80669
Lincoln, Nebraska 68501
(800) 228-4630

Videodisc Music Series

Ed Schwartz
NEH Videodisc Project
Instructional Resources Center
University of Delaware
Newark, Delaware 19716
(302) 451-2685

DRAW Videodiscs

Spectra Image
540 N. Hollywood Way
Burbank, California 91505
(818) 842-1111
Larry Spangler

Technidisc
2250 Meijer Drive
Troy, Michigan 48084
(800) 321-9610

MAKING MUSIC WITH A MICROCOMPUTER

Roberta C. Russell

Not too many years ago the guitar, tarnished by its association with rock musicians and alternate lifestyles, was largely ignored by the music education establishment. Its popularity with students persisted, however, and today "guitar literacy" (to paraphrase a current idiom) is a required course for most music education majors.

Another musical revolution not unlike that of the 1960's is upon us. Digital music, once the province of university graduate students and commercial recording studios, is now available at your local K-Mart. Access to studio quality sound from inexpensive electronic keyboards has provided this generation of students with a new "folk instrument" and the interface of synthesizers with microcomputers makes it possible to compose, record, playback and edit music without having to develop traditional performance or notational skills. Music teachers cannot afford to ignore the impact of this technology both on their students and on the future of music.

Digital Music Synthesis

The sounds we hear as musical tones are created by vibrating objects or materials that move the molecules in the air backward and forward. Such soundwave patterns are called waveforms. Digital music synthesis is a process by which waveforms are represented in a computer as "slices" or measurements of a wave. Numbers represent musical values such as pitch, dynamics, envelope and timbre. These numerical representations of waveforms are computed and stored in memory for later recall. The method for converting them into physical sound varies depending upon the computer system. With digital synthesizers we can imitate natural, acoustic sounds, or create new sounds from our imagination.

Types of Digital Synthesizers

A variety of digital sythesizers are available at an affordable price for the music classroom. Many of these are built-in to existing models of computers already popular in schools, while others exist as plug-in boards. Still others are stand-alone electronic instruments that can be interfaced with a microcomputer by means of a music industry standard known as MIDI (Musical Instrument Digital Interface.)

Built-in sythesizers

If your school owns a Commodore 64, you already have a music synthesizer. You will need to upgrade the audio by routing it through a stereo system, and add a clavier or piano-type keyboard with appropriate software. Such keyboards are now available from a number of manufacturers including Melodian, Inc., Waveform Corp., and Passport Designs, to name just a few.

The C-64 contains a bonafide music synthesizer called the Sound Interface Device with three independent voices, each with a programmable four-step envelope; triangle, sawtooth and white noise waveforms; high-pass, low-pass, band-pass or notch reject filters; synchronization and ring modulation. Features identical to these are found on many professional music synthesizers.

Other computers that come equipped with less sophisticated sound chips are the Macintosh (four voices), Atari (four voices), Vic-20 (three voices), the TI/99-4A (three voices), and the IBM PCjr (four voices). The trick of course is to find the software and add-on hardware to make the fullest use of the system. The August issue of Family Computing has an excellent summary of products available for the C-64, as well as for other computers.

Plug-in Boards

The APPLE II computer has no built-in synthesizer, but a number of plug-in boards have been developed for it.

The ALF MC1 Music Card is a nine-voice synthesizer which comes with its own music-writing software. Although envelope and volume settings can be modified, the only waveform available besides a pseudo white noise function, is a square wave. As a result, everything sounds like a somewhat reedy organ. While not flexible enough for sophisticated composition, the MC1 supports Terrapin's new MUSIC LOGO, said to be due out soon.

Mountain Computer manufactures a truly professional sounding synthesizer-on-a-board for the Apple. The Mountain Music System consists of two connected hardware boards that are insterted into consecutive slots of the

Apple. Sound is generated by sixteen programmable digital oscillators grouped in two clusters of eight. The user has contol over each waveform as well as a six-step envelope, vibrato and other special effects. The addition of a Soundchaser or Syntauri keyboard turns the Apple into a true digital keyboard instrument, with the ability to record and perform music in real time.

The Mountain Music System system has only recently been surpassed by the introduction of the MIDI interface and compatible stand-alone instruments. The Wenger Corporation, a music education supply house, has taken over the manufacture and distribution of the original Apple-Soundchaser system. The Soundchaser is now based on a different (and said to be improved) synthesizer board.

Another plug-in board familiar to many music educators is the MMI (Micro Music Inc.) board. This board is not a synthesizer in the true sense of the word, but rather a DAC (Digital to Analog Converter) that supports MMI's extensive library of music CAI programs. It is used almost exclusively to generate multiple voices for ear-training exercises.

If you are interested in turning your APPLE into a drum machine which can accompany your students with preset rhythms and a variety of percussion sounds, several manufacturers make boards that do just that. Drum units simulate the sound of a drum set and create reproductions of rhythms from marches to salsa. PVI makes an interface board/software package that uses digital recordings of actual percussion sounds. Students can compose, play, record and playback rhythm patterns to provide a background for singing or playing other instruments.

Stand-alone Keyboards and the MIDI connection

With the recent introduction of the MIDI standard by the music industry, it is now possible to link any MIDI equipped synthesizer to a computer equipped with MIDI hardware and softweare. Several companies market MIDI interfaces for the Apple, Macintosh, Atari, Commodore, and IBM computers.

MIDI systems provide many of the capabilities of expensive recording facilities at a fraction of the cost, and permit easy exploration of the imaginative techniques used in contemporary electronic music. The importance of MIDI is demonstrated by the tremendous amount of MIDI software that has been generated in the past year alone, and the establishment of a special organization, the International Midi Association, to keep music industry professionals apprised of current developments.

Like many other forms of digital technology, the quality of stand-alone keyboard synthesizers has gone up while the cost continues to fall. According to the Computer Music Association, the most exciting new synthesizer introduced at the recent National Association of Music Manufacturers convention is made by Casio. The company introduced two instruments: the CZ-101 and the CZ-1000. Both are identical except that the CZ-101 has smaller than standard keys and is smaller overall than the CZ-1000. Both instruments are fully digital and compare favorably with the Yamaha DX-7, a $2,000 keyboard used by professional rock groups. They are four-voice instruments and can receive four channels of MIDI simultaneously. Under computer control you have the equivalent of four independent monophonic synthesizers. They constitute one of the most portable, high quality and lowest-priced MIDI instruments on the market.

Music Computers

The MIDI interface is now being integrated into personal computers just as synthesizer chips are. The new Atari ST computers and the Yamaha Music Computer have a built-in MIDI interface. The Yamaha has in addition, a built-in eight voice synthesizer with sound quality said to rival the company's DX-7 digital synthesizer.

The Yamaha Music Computer is currently marketed to musicians for use as a composition tool. However Yamaha plans to start using it within the next year or two to help teach music in the company's 165 studios throughout the U.S.

MICROCOMPUTER APPLICATIONS
IN
HEALTH AND PHYSICAL EDUCATION

Ernest A. Randolfi

Microcomputer use in health and physical education is growing rapidly, and this growth is documented by the recent proliferation of related literature in professional journals. In October of this year Health Education will publish its second special edition issue devoted entirely to the use of microcomputers in health education. In 1984 both The Journal of Physical Education, Recreation and Dance and The Journal of Nutrition Education also published special issues devoted to microcomputer use. The special issue of The Journal of Nutrition Education listed over 100 nutrition-related software programs and reviewed about 50 of them.

The extent of commercially available software programs has fostered the need to reference health related software sources into a convenient index. The Office of Disease Prevention and Health Promotion in the Department of Health and Human Services has published two comprehensive lists of currently available software (NHIC, 1984); one addresses computerized health risk appraisals (HRA) and the other is a compendium of health promotion software. Both documents give a brief description of the available microcomputer programs, the price, and their source. Also included are useful guidelines for the evaluation of health promotion software.

Careful evaluation of health related software is an important issue because although a large quantity of software is available, the quality of the currently available software is limited. McDermott and Belcastro (1983) have suggested that much of the software is either written by programmers that don't know much about health education or by health educators that don't know much about programming. The same can be said for educational software in general. In a recent study evaluating educational software, "only 5% of the hundreds of programs reviewed were judged to be of truly high quality, and more than half of the software was judged not worth recommending to educators or parents" (Komoski, 1984).

If this is to change, all educators including health and physical educators will need to become more wary and demanding of the software they are purchasing. Buying software can be an expensive and confusing ordeal. Potential consumers should be cautioned to first establish their objectives and then evaluate software to see if it meets their needs.

The criteria for the evaluation of health and physical education software may differ from that used to evaluate other educational programs. For example, when examining health promotion software one should be especially cautious of supporting documentation that does not list references. Since recommendations for personal health enhancement are often controversial, educators should utilize references to validate software content.

The evaluation of health and physical education software is unique in other respects. Unlike other disciplines, health related computer assisted instruction is not limited to the transference of knowledge and facts. The fields of health and physical education are uniquely involved in motivating people to change and/or maintain health enhancing behaviors. Knowledge alone is frequently insufficient to change health behaviors (e.g. most of the people that smoke cigaretts are aware that smoking is bad for their health, yet they continue to smoke).

Student involvement in the subject matter is often encouraged as an educational strategy. Along with teaching facts, computer assisted instruction in health and physical education should motivate and promote personal decision making about health behaviors.

One program has attempted to increase seatbelt use among teenagers by interactively asking students to respond to questions related to seatbelt usage. This program gets students to question some commonly held myths about the ineffectiveness of seatbelts in saving lives and preventing injuries. The ability to reinforce good health decisions and also get students to question and reflect upon the not so positive decisions they may make is an attractive feature of this program. In addition, creative graphic images are used to illustrate and bring to life the otherwise boring statistics of seatbelt usage.

The "number crunching" ability of microcomputers is also often taken advantage of in many health and physical education software packages. This is especially true in the personalized health assessment applications. The most popular programs include health risk appraisals, nutritional analysis and physical fitness assessments. These programs offer many powerful innovations to the health and physical education classroom, however, the potential also exists for the misuse of this technology by those that have been inadequately trained in their application.

The results of computerized health risk appraisals (HRA) are often given to people without also providing the opportunity to have the output interpreted by qualified health educators. Health risk factors for these instruments are generally derived from studies that involve middle class, middle aged, white subjects (Berry, et al., 1981). Persons reading results on their own may not be aware of how HRAs are constructed and thus will not know the limitations of applying normative data to individuals. The black teenage student living in the inner-city ghetto will not have the same health risk factors as the white student living in the affluent suburbs of the same city. Extrapolating data to make lifestyle recommendations for individuals is not as simple as some microcomputer programs make it seem. The necessity of properly training educators is indicated in the use of HRAs.

Similar precautions are reflected in the use of nutritional assessment programs. Research has indicated that people will not be able to properly interpret the results of some diet analysis programs without assistance (Smiciklas-Wright, et al., 1984). As an illustration, individuals may not understand how to use RDA values (e.g. what is the significance of having 86 percent of one's RDA for selenium?). Teachers should also beware of conveying a false sense of accuracy when using programs that measure nutrient content of foods to the nearest microgram. Students should understand that the nutritional content of foods can vary greatly depending on how the food product was grown or processed, shelf life, refrigeration, and cooking method and time (Rogan & Yu, 1984). There is a tendency to view output from nutritional analysis as precise measurements fostering unwarranted credibility. Teachers should inform students that the results are, at best, good estimates of their nutritional intake.

In utilizing health assessment software, health and physical educators should lend credibility to microcomputer programs, microcomputer programs should not necessarily lend credibility to the educator using the software. If educators intend to use the various health assessment programs they should be prepared to interpret output for their students or provide learning opportunities which address these application issues.

In addition to health assessment software, computer assisted instructional programs are also available to help students learn in exciting new ways and develop skills which will encourage good health practices. The interface of biofeedback instrumentation with the microcomputer offers a demonstration of how the microcomputer can teach useful life skills. Biofeedback instrumentation is often used in stress management education. By providing immediate visual and auditory feedback of a variety of physiological processes, students can learn to consciously control levels of emotional arousal and subsequently improve their ability to handle stress. In physical education these devices can be used to illustrate exercise physiology principles and to track improvements in fitness levels. Programs are available to interface with instruments that measure heart rate, muscular tension, body temperature, galvanic skin response and body fat.

Interactive videodisc systems exemplify another way that technological advancements can promote learning in health and physical education. The quantity of health information is doubling every five years. Future educators and students will come to rely on the microcomputer as an information retrieval system. Fast access to an extensive library of visual images and auditory recordings provide a new and stimulating dimension to learning environments. Interactive videodiscs are already being used to teach cardiopulmonary resuscitation via a self contained system that includes the interface of resuscitation manikins, video discs, and the microcomputer (Hon, 1982).

In addition to transferring information, assisting in decision making, and teaching skills the microcomputer is often used as an instructional management tool in physical education. Organizing sports tournaments, team rosters, and game statistics is time consuming for educators with large classes. A variety of software is now available to help physical educators facilitate the management of these tasks.

As a result of the continuous development of health and physical education software, microcomputer use among educators will continue to grow. In the future health and physical educators will find the need to develop new skills. From the perspective of teaching Jerome Popp, has prophesied that the microcomputer will take over many of the didactic chores of instruction and allow educators more opportunities to develop heuristic and philetic teaching skills. Precisely the skills needed to encourage positive health behavior changes in students.

As discussed the microcomputer offers instructional opportunities not available through other educational media. Software should take advantage of the computer's unique qualities as a teaching machine for health and physical education. Microcomputer applications presently utilize quick information retrieval, calculating ability and interface possibilities. As the applications for microcomputers increase in health and physical education, the need for professionals trained in these applications also grows. Professionals will be required to assess both the subject content matter and the instructional characteristics of microcomputer software. If this occurs the population of students that graduate from schools every year may be healthier as well as more knowledgeable.

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SOME THINGS THEY FORGET TO TELL US ABOUT EDUCATIONAL COMPUTING

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We all remember Hans Christian Anderson's story of the emperor's new clothes. Everyone could see that the emperor was unclothed, the difficulty was, in the context of the moment, to perceive it. What it took was for someone unabashedly literal minded to point it out. This paper takes a similar literal minded approach to the uses of computers in education.

One thing we do know is that we are in the midst of a scientific and technological revolution. Members of the press and the scientific community have been vying with each other to capture in print the magnitude of what is occurring. One popular statement is:

> If the automobile had accomplished in the last 20 years what the computer industry has, a Rolls Royce would cost $2.95 and get 2,500,000 miles per gallon of fuel.

Despite the appearance of hyperbole, this statement is reasonably accurate. Despite all the rhetoric, there is considerable substance to what is now taking place.

"Order of magnitude" seems to be a notion for describing what is going on. Briefly, a change in order of magnitude of some value is a division or multiplication of that value by 10. An order of magnitude increase in 10 is 100. An order of magnitude decrease in 100 is 10.

Thanks to the development of the steam engine during the 18th century, our efficiency in accomplishing physical work increased substantially. By enhancing the power of what was basically a tool for the hands (and perhaps feet), we brought about the Industrial Revolution. As a result, the proportion of the labor force required to grow our food declined from well over 50 percent of the population to less than 5 percent -- an order of magnitude reduction. Coach travel, which proceeded at a rate of 2-3 miles per hour, was replaced by railway travel at 40-50 miles per hour -- well over an order magnitude increase. After it was fairly well settled in, the Industrial Revolution gave use effects in the range of 2-3 orders of magnitude improvements in our ability to accomplish physical labor (Jones, Holton, and Stratton, 1982).

Today's electronic, stored-program computer was developed in the mid-1940s and integrated circuits (computer "chips") were developed in the mid-1950s. In concert with a few other developments, such as LSI (Large Scale Integrated) circuits, which increased the components on a chip from about 10 to more than 10,000, we were, in a span of about 20 years, able to increase our computational capabilities by about 6 orders of magnitude, compared to the perhaps 1 order of magnitude increase accomplished over the previous 2,500 years. Based on VLSI (Very Large Scale Integrated) circuits, we should accomplish another 5-6 orders of magnitude improvement in our computing power in the next 15 years. By the turn of the century, then, we should accomplish a 12-order of magnitude improvement in what is essentially a tool for the mind (Shepherd, 1977). When faced with the task of identifying and describing the implications of this development the imagination understandably boggles.

Educators, of course, have recognized the possibilities of this revolution. In Fall 1980 there were 31,000 microcomputers available in the nation's classrooms. This number increased to 96,000 in the Spring of 1982. By Fall 1983 there were 250,000 microcomputers in schools (Melmed, 1984), 55,175 of the nation's approximately 83,000 schools had microcomputers, and 15,509 of these had six or more microcomputers. Those who are familiar with the rapid growth in this business will be justified in considering Fall 1983 to be ancient history.

It should be emphasized that it is not just the imagination that boggles in the face of these developments. There are many people who find the electronics revolution to be, frankly, revolting. Some of these people are teachers and school administrators. Their attitude is understandable. Having mastered at considerable cost the standard school technologies of blackboards, lectures, laboratories, and textbooks, they are now confronted with unfamiliar devices that promise to undo or at least fundamentally alter everything they have learned. That these devices should create both excitement and concern within the educational community is not surprising.

Attempts to meet these concerns may result in overselling current capabilities for appropriate applying computers in education. There are instances where genuinely false information has been unleashed on the unwary. However, my concern here is with the honest efforts of those who wish to see the revolution through, and who have committed their professional lives to helping us all realize the potentials of educational computing. However, there are a few items that seem worth mentioning.

Many of these items will come as no surprise to an audience made up of computer educators. The service I hope to provide in this presentation is simply that of a recorder. I have listed some items that we all probably know, but that we might forget if they were left unrecorded. Of course some items are more controversial than others. I present a dozen of these, listed in no particular order. I am sure there are more.

1. **Drill and Practice works.** 'Drill and practice' is one of the more regrettable terms in instruction. It evokes images of the classroom as a sweat-shop and attracts the ire of those who would use computers to create a rich and friendly learning environment for intellectual exploration and discovery in the classroom. Certainly it is now fashionable to deprecate drill and practice as a computer instruction technique, and it has been so for the last five years. Papert (1980) cites drill and practice as an example of the QWERTY phenomenon -- an approach that originally made sense and was even necessary, but an approach that is now no longer necessary or desirable. His argument is that neither classroom teachers nor computer technology would initially accept instructional formats other than drill and practice -- now that they will, drill and practice simply hangs on as a sort of computer-assisted anachronism.

   This is a cogent argument, and it elicits wide-spread sympathy and agreement. The problem is that drill and practice works and works very well -- in fact it seems to work better than almost any other approach for using computers to teach, with the possible exception of simulation. There is more about that to be said in a minute, but first we should turn to main-line, hardcore drill and practice.

   There is a current notion that drill and practice instruction represents little more than an unimaginative process of throwing random items at students until they get some arbitrary number of them correct. Unfortunately, this is true of some drill and practice presentations. However, there have been far more sophisticated uses of computers in drill and practice formats. These have included thorough analyses of elementary school mathematics curriculum goals and the development of equivalence classes of items, strands for instruction, and transition algorithms for progress through the material (Suppes and Morningstar, 1969), applications of digitized audio for teaching beginning grading (Fletcher and Atkinson, 1972), applications of optimal control theory to select items for presentation (Atkinson and Paulson, 1972), optimal branching among strands based on a controller estimator system (Chant and Atkinson, 1973), and trajectory theory for allocating time for precise achievement of individualized curriculum goals (Suppes, Fletcher, and Zanotti, 1976).

   The sophistication of these approaches is matched only by more recent applications of artificial intelligence techniques to provide interactive, mixed-initiative simulations in which either the computer or the student can guide instructional activities. These simulations are often contrasted with drill and practice approaches. But what is the intent of these simulations other than to provide practice?

From the standpoint of instructional objectives, drill and practice and simulations have more in common than we might expect.

It should be notable that I, and others, exclude from drill and practice approaches the page turning, programmed textbook approach based on intrinsic programming (Crowder, 1959) that is so common in computer-assisted learning. There seems to be little enthusiasm for this approach aside from the many materials developers who use it before they begin to understand the full capabilities of computers in instruction. This type of approach does not seem to work very well, but it is very popular.

At this point, it would be a good idea to review studies of drill and practice to see how proficient they are in increasing measured student achievement. However, in the space available here, not much can be presented. Nonetheless, it is notable that what seems to be the first "meta-analysis" of computer-assisted instruction evaluation studies was published in 1972 (Vinsonhaler and Bass), that it covered 10 studies involving over 10,000 students, that all studies reviewed were successful, and that all 10 studies involved drill and practice. Most recenly Leslie Gatewood reviewed the effectiveness of drill and practice applications in elementary school (1984). Of 60 experimental groups considered in this review, positive results in measured achievement were obtained in 50. Suppes, Fletcher, and Zanotti (1976) demonstrated that it was possible to predict student achievement measured by standardized tests to the nearest tenth of a grade placement based solely on the amount of time students spent on the computer-presented material.

Given this history of research and development, it seems reasonable to conclude that drill and practice can be both a sophisticated and successful use of computers in education. Nonetheless, there is still plenty of opposition to the idea of computers being used for drill and practice in schools. In the absence of supporting data, this attitude may be due to the impression that drill and practice is somehow less warm, less friendly, less humanizing than other approaches. This brings us to the next point.

2. **Computers can humanize education.** A dominant metaphor in education is that of a single teacher working in a close relationship with an individual student where needs of the student are being met through this relationship with a knowledgeable and sympathetic adult. Plenty of our teachers are both knowledgeable and sympathetic, but few have an opportunity to bring this metaphor into reality. The actuality is better represented by a single teacher facing a

class of 25-30 students. Simply on the basis of numbers alone, a teacher cannot interact sufficiently and individually with these students no matter how committed he or she is. This difficulty is corroborated by research that reports the amount of individualized instruction a student receives in the classroom to be about 2 minutes per day.

Numbers of students are not the only reason for this difficulty. A well-known rule of thumb for the spread of ability in elementary and secondary school classrooms is that there is one year of difference in student ability for every year increase in grade level. In other words, there are likely to be 6 years of difference separating the highest from the lowest performing sixth graders, 8 years of difference in eighth grade, and so on. Therefore, the teacher must not only deal with 25-30 students in a classroom, but with an intractable range of abilities as well.

How can a teacher deal with this diversity? The answer is not very well. Some jobs are impossible and classroom teaching seems to be one of them. Enter the computer. The role of the computer is not to take over teaching. We know that the ideal instructional setting is one (human) teacher and one student, and we know that this ideal is impracticable. The role of the computer is to help fill the gap between the ideal and the actual.

We need to know much about the use of computers as tools for classroom teachers and for students, but the ultimate objective is the greater humanization of our instructional settings. Presence of a human teacher is no guarantee of a 'more human' approach to education, and presence of a computer does not imply its absence. Computers can increase the amount of individualized instruction received by students from 2 to 40 minutes, which is now being accomplished in a number of operational school settings. Additionally, computers make it possible for teachers to increase their contact with students. All this is possible, if not inevitable, provided we do not lose sight of the end objective -- which brings us to the next point.

3. **Design is important.** The revolution in instructional computing did not begin in 1975 with the introduction of microcomputers. The first book of readings concerning instructional uses of computers was published in 1959 (Galanter), and the history of subsequent research is substantial and significant. What did happen with the introduction of microcomputers was a substantial revolution in the accessibility of computing. Computing was no longer the province of a computational priesthood, but available to anyone with a few thousand (later a few hundred) dollars to spend for a com-

puter. Practically overnight any 2 people in a garage could open up a software shop and put themselves in the curriculum business -- not only they could, but they did. Currently, there are about 700 publishers busily adding to the more than 2,100 software titles now available for the educational market (Melmed, 1984).

One might well wonder how carefully the principles of instructional systems design are being followed by these developers. In other words, are they performing a careful and detailed analysis of the instructional needs to be addressed, devising appropriate objectives, designing instructional interactions to achieve these objectives, devising delivery systems that are appropriate for these design choices, developing and carrying out implementation plans that meet the needs of the students, teachers, and administrators who will use these materials to determine both their ability to meet the stated instructional objectives and the appropriateness of the objectives themselves, and redesigning the materials based on the resulting evaluation data? These are the steps for the development of instuctional materials. They are somewhat standard and they have been examined and discussed extensively in both research and practice. Are they considered by developers?

As one who has been involved in about a dozen major instructional software design projects, I would be surprised if more than a few of these steps are taken seriously by developers. Maybe the reality is that all our instructional design machinations are a snare and a delusion. I suggest the contrary.

As evidence, I present the current state of instructional software. There are clever interactions available but what are their objectives? What data can be presented concerning their instructional effectiveness? How are they to be integrated into standard classroom practice? How is progress measured and reported to students, teachers, and administrators? What instructional needs do they meet? These are questions that require answers before instructional materials can be used successfully in classrooms. Instructional systems design procedures were developed to assure that they can be answered. The point is that design -- proper design -- concerns both the internal structure of the materials themselves and the structure of the instructional environment in which they are used. The two major questions that seem to face us in computer-assisted learning are, first, how do we best design materials for presentation on computer, and, second, how do we integrate these materials into classroom practice. The second question is the more difficult one, but both are addressed by instructional systems design procedures.

This third point may suggest that design of materials for instruction is not a simple matter. It isn't, and that brings up the next point.

4. **Good courseware is expensive.** The first computer-based instructional design effort I was involved in concerned development of reading materials for presentation on an IBM 1500 System. This effort took place in the mid-1960s. The computer system was a prototype and cost about $2.5 million. It was a 32K (!) time-sharing system that supported 30 student terminals with randomly accessed photographs, light pen, CRT display, limited and cumbersome graphics, analog audio input and output, and keyboard. Cost of instructional materials development was about $1 million. In the early 1980s, I was involved in the design of two other reading curriculums for computer presentation. Again, the delivery machine supported a 30-terminal time-sharing system. The central computer system had 4 megabytes of primary memory with an additional 80 megabytes of secondary memory. Each student terminal had full graphics support, a keyboard, and audio output. The cost of the system was $80,000. Cost of instructional materials development for each of the curriculums was about $800,000. Costs had changed substantially for the computer hardware and software, but the costs of curriculum development changed far less -- and they were still high.

   It should be emphasized that these were sizable curriculums. These curriculums were each intended to be used for about 20 minutes every school day for 1-3 school years. However, they also involved carefully devised and explained instructional objectives, they incorporated teacher preparation materials and workshop designs, they provided several different types of reports on student progress to be used by students, teachers, and administrators, and they were modified based on data returned from functional evaluations. They were and are successful in achieving their instructional objectives.

   It may not be necessary to spend $1 million to devise quality software, but it should be apparent that software development is not to be undertaken casually or treated lightly. Developers are currently able to neglect instructional systems design principles because they can do so and still market their products. This state of affairs is likely to change in the near future. I suggest that the sooner it does the better for all of us.

   The subject of instructional system design introduces the objectives of design which in turn introduces my next point.

5. **Learning is the object.** A major contribution of the current "cognitive" movement in psychology has been to show us -- or

remind us -- that perception and learning are overwhelmingly active, constructive processes (e.g., Resnick, 1983). In instruction, as in all communication, we are not simply shipping chunks of information across a channel to be pasted intact onto a blank slate. This conception may be appropriate for information theorists, but not for those who must understand how human beings function. What we seem to be doing in instruction is passing cues that the receiver -- the learner -- uses to build, verify, and modify sensory simulations of the world. The principal mechanism of learning and perceiving seems to be unadulterated analysis by synthesis. Memory itself appears to be reconstructive, or re-creative, rather than reproductive. We do not simply dredge up items for recall, we reconstruct them. Perception, memory, and learning all appear to be creative processes.

When it comes to instruction, then, it appears that we do not simply teach by dumping whole chunks of information into students' heads. Rather, our task seems to be to create environments in which learning is encouraged to take place. It appears that the creation of environments in which students are encouraged and aided in developing their own simulations of reality may comprise the most efficient contexts for learning. Perhaps this conception explains why spoon-fed instruction such as we find in approaches based on programmed textbooks yields such mixed results and approaches in which students practice on material learned elsewhere such as in drill and practice and approaches in which students are free to explore and test their own hypotheses such as in simulations more commonly yield successes. In any case, the object of instruction design should be to create environments in which learning is aided and encouraged. Teaching is important, but the learner is where the action is.

This consideration begs the question of whether or not computers can be designed to be sufficiently creative and generative to keep up with learners who are building, verifying, and modifying their simulations of reality. It would provide an excellent introduction for artificial intelligence applied to instruction -- were it not for the next point.

6. **Artificial intelligence isn't.** These days the application of artificial intelligence in all areas are better characterized by promises than substance. What we have accomplished so far is not intelligence -- not yet.

This may be a little hard on what is probably the most promising area of research in the business of using computers to teach. Even though we cannot afford to put an expert human tutor on one end of a log and a single student on the other, we might be able to supply the student with a computer that

> incorporates many of the qualities of a human tutor. However, anyone who sees the promise of this area has to be a little put off by the over-promises of those who are currently seeking to realize its market potential. The problems of instruction are substantial, and the development of artificial intelligence -- let alone its application -- is in its infancy.

Consider the following example (Norman, 1973):

What was Charles Dickens' telephone number?

A knowledgeable program would search the attributes it had associated with Charles Dickens looking for a telephone number, and/or it would search its list of telephone numbers looking for one associated with Charles Dickens. Presumably, no telephone number will be found for Charles Dickens -- at least for the Charles Dickens --, and this fact will simply be reported. As most human information processors must be aware, there is a more intelligent answer to this query that completely avoids searching lists of telephone numbers and/or attributes. To reply that telephone numbers were not used until after Dickens' lifetime does require some knowledge, and this information could easily be stored by a computer. The real problem is to devise a computer program that knows when this information is relevant.

Just how well computers will solve problems remains the subject of considerable debate (cf. Dreyfus, 1972; Wiesenbaum, 1976). However, the problem is not solved yet, and it is a major component of problem solving. We can get a computer to solve systems of simultaneous, non-linear equations without a great deal of trouble. The real advance will come when we can get a computer to decide that solving a system of simultaneous, non-linear equations is a worthy goal. We can train computers to do the former. The latter requires an education.

In order to substitute for human tutors, computers must learn to separate what is relevant from what is irrelevant, and they must learn to form intentions, goals, and perhaps even desires. One other requirement remains. Computers must be able to solve problems the same way their students do. If they cannot, they will not provide consistently adequate explanations to students, and they will not be able to model students' misconceptions about the subject matter and thereby "debug" their procedures and modify their simulations. It is all very well to be an expert, but if you cannot model what students do, you are not likely to be a good tutor -- even if you are a computer.

In summary, we need artificial intelligence, but we don't have it yet. On to the next item.

7. **Computer literacy requires instruction in programming.** Now we have hit on something that should stir up a few people. Maybe I can put them a little more at ease. The clarion call for computer literacy was first sounded by Arthur Leurhmann in 1972. In his discussion, Leurhmann suggested that after several thousand years of reading and writing in natural language, we are about to launch a new form of literacy which will be universally required for reading and writing in formal languages, that is/was to say reading and writing in computer languages. In short, the original notion behind computer literacy was that it definitively required computer programming.

Now, of course, we can argue for computer literacy as knowledge of computer science on the aristocratic side of the spectrum and for computer literacy as knowledge of computer applications on the proletariat side with computer literacy as knowledge of computer programming somewhere in the middle -- perhaps representing the bourgeois. The point I want to make is that whatever we do, when we teach computer literacy we ought to teach computer programming.

This point of view is not as fatuous as it may seem. I claim my salvation lies in why I want to teach programming. Very shortly, if not now, we will be inundated with microprocessors. At present our industrial capacity is producing about 1,000 bits of memory for every human on earth. By the year 2001, our annual production should reach 1 bit for every neuron in every human brain on the planet (assuming 2.5 billion neurons per each of 5.8 billion humans expected to be around then) (Jones, et al. 1982). At that time we should be finding microprocessors everywhere we look -- in our radios and television sets, in our hairdryers, in our toasters. Is there anything we can do to prepare people for this new age of microprocessor plentitude?

There is one feature that all these processors have in common -- and in 2001 will have in common even if we break through the Von Neumann architectural bottleneck. All these processors will function using what automata theory calls effective procedures (e.g., Minsky, 1968). Informally, an effective procedure is just a very specific and very detailed procedure for solving a problem. It can be implemented on a formal machine called a finite state automaton, but the main thing to note about effective procedures is that they are the basis for programming languages -- they are the formalisms that give all programming languages their very deliberate step-by-step character. Every century contributes some key ideas to our cultural history. The formal and fundamental expression of effective procedures is probably one of the two or three key ideas that will emerge from our 20th century.

Be that as it may, if we are concerned with education as the ultimate transfer skill, we will not do our jobs as educators if we do not provide our students with an intuitive understanding of effective procedures as preparation for the coming world of computational plenty. How can we do this? What is the single best instructional approach to use in getting across the idea of an effective procedure? By now everyone should know what is coming. We all have the impression when we first learn to program that we have learned something more than just a programming language. This impression is reinforced when we discover how much easier our second programming language is to learn than the first. I claim that what we have learned is an intuitive understanding of what an effective procedure is. Moreover, I claim that this understanding is an invaluable foundation for all uses of computers whether we approach them at the applications level, the programming level, or the computer science level.

Hence, I recommend we teach our students to program, not as a form of literacy in its own right -- although I have no objections to this rationale -- but as a key to unlocking an understanding of the computational future they face. In other words, I recommend we teach our students to program for the same reason we teach them Shakespeare -- it is an essential component of a 20th (and 21st) Century liberal education. It is essential because it provides an effective transfer skill for dealing with a world full of microprocessors.

At this point it is probably time to return from issues of teaching about computers. The next item concerns uses of computers as tools for education.

8. **Evaluations aren't.** Many of what we call software evaluations are accomplished using checklists provided by EPIE or MicroSift or whomever. Do we know if any of these evaluation instruments are valid? Do we know that software ranked high on checklist item 'X' is any more effective than one ranked low? The intuitive answer is yes. However, we cannot back up our intuitions with data. The major lesson we have been learning from Galileo on is that our intuitions appeal and what the test makers call face validity, but we have very little data to indicate whether the face validity of these items is matched by genuine, substantive validity. Of course these checklists are an important and even essential component of software evaluation, but they are not the whole story.

   However, even evaluations that pass muster with methodologies fall short of what we need. That is because they treat educaitonal outcomes as unidimensional results. If they can reliably measure achievement gains on a standardized instrument under controlled conditions, they tend to be satisfied with the result. The problem here is that a proper evaluation should consider a variety of outcomes, all of which were objectives, either implicit or explicit, of the instruction designers. In addition to accuracy of performance on an achievement test, what about speed of performance, long-term retention of performance, transfer of performance in related areas, motivation to continue study, ability to teach the material, etc.? All of these are proper objects for evaluation studies, and few of these are ever considered.

Briefly, I recommend that we learn to become dissatisfied with our evaluators, and that we demand much more of them. I do not wish to denigrate what they do so much as their claims for it. Their evaluations aren't, and we should insist on much more if we care to advance the quality of available educational software.

Mostly what we discussed here concerned effectiveness of educational software, but that is only half of the story -- as the next point attempts to show.

9. **Costs count.** The educational literature is full of recommendations of what students, teachers, administrators, curriculum designers, and even researchers should do. The problem with all these recommendations is that they are addressing what economists call a closed system. That is just another way of saying there are only so many hours in a day and so many dollars in a budget. The educational innovators and reformers are fine as far as they go, but they all too rarely say what we should give up to make way for their recommendations.

   Sooner or later we must consider the issues of cost. It is very clear from the evaluation literature -- I mean real data here, not just software reviews -- that by providing one adequate computer or computer station for every 15 elementary school students in the state of Oregon, that we can raise their composite arithmetic scores on any standardized test we choose a minimum of 20 percent. Now what is that worth? If we assume that there are about 300,000 elementary school students in the state, that means we would have to provide them with 20,000 computers or computer stations to achieve our 20 percent increase in composite arithmetic scores. Assuming $2,000 per computer or computer station -- including software and maintenance, that means the whole business would require a capital outlay of $40 million. Again assuming that all these machines and their software would last for five years, that means an annual expenditure of $8 million. Out of an annual budget of $750 million for elementary school education, that is not much to ask for. In fact, it is about 1% -- even less than David Moursund's 2% solution (1984).

However, we have to ask what that $8 million is being used for now -- in other words, what must we give up in order to gain our extra 20% achievement in composite arithmetic scores, and is this a trade we want to make? At this point we have the sort of issue that our educational decision makers can get their teeth into, but we arrive at this point only by considering costs along with effectiveness. Those of us who seek to effect change in the schools are going to have to advocate innovation in terms with which those who make the changes are familiar. This brings up the next point.

10. **Education doesn't matter.** For many years educators have been asked what they were spending the public's money for. For almost as many years educators have been able to reply that they were spending the money to improve education. This reply used to suffice. Times have changed. In arguing for support for education, we seem less and less able to argue for improved education as an end in its own right. Instead those who make decisions about the expenditure of public money (i.e., taxpayers and their elected representatives) are more and more inclined to ask the next question -- what is a pound of education worth? What does it benefit the commonwealth to improve education? We all sense that there are good answers to this question -- if we did not, we would not have committed our professional and to a considerable extent personal lives to education. But what are the answers? There are sophisticated and concerned people asking the questions. Where are the numbers? Where are the data?

    It seems egregiously myopic to claim that it is not the business of educators to defend education. Who else is going to do it? In short, we who are interested in the development and use of computers in education had better spend some time and resources preparing answers to the basic and increasingly common questions. We cannot leave this task to others because there are no appropriate others to leave it to.

    Our neglect of this area is a partial, but only partial, explanation for the next term.

11. **The revolution has not yet begun.** In twenty years or so it is going to be possible for everyone to have a Ph.D. They will not necessarily earn Ph.D.s, but they will be able to carry around in a shirt-pocket sized packet a Ph.D. worth of information on any topic of their choosing. Whether or not the marketplace will support widespread adaptation and distribution of this capability remains to be seen, but the capability will definitely exist. The chores of problem solv-

ing will all be done for us, and we will have full opportunity to concentrate on the strategic aspects of problem solving. In other words, we will be free to spend most of our time deciding what problems to solve rather than solving them -- that will be done for us. How should we educate our students for a world of this sort? They will need principles, not procedures. They will need heuristics, not facts.

In 1960 T.F. Gilbert wrote:

> If you don't have a gadget called a "teaching machine," don't get one. Don't buy one; don't borrow one; don't steal one. If you have such a gadget, get rid of it. Don't give it away, for someone else might use it.
>
> This is the most practical rule, based on empirical facts from considerable observation. If you begin with a device of any kind, you will try to develop the teaching program to fit that device (p.478).

Gilbert is partly right. Not only will we fit the teaching program to the computer; we will have to. Gilbert is partly wrong. To suggest that we should not pursue new technologies for this reason is to deny the entire history of educational progress.

I have few answers to these difficult issues. But at least we must be aware that the changes we are going to see in the processes of instruction have barely begun.

Based on the preceding lucubrations, the next final issue is predictable -- if not inevitable.

12. **The experts aren't.** The one thing you can be sure about is that no one really knows what is going to happen in educational computing. This is a field marked by tremendous breadth, but very little depth. It does not take long to become expert in some corner of it, but proper perspective is impossible to develop because once you compile sufficient breadth for perspective the whole field metamorphoses. Moreover, the lack of depth means that any inferences based on current states are likely to be faulty.

Since we have ended up here, there should be very little that I or anyone else should add. Let us simply conclude, then, that the uses of computers in education present us all with opportunities and challenges. They will fundamentally alter what we do in education. More importantly they will alter what we want to do in education. We are all being overtaken by events. We should all view it as an opportunity to excel.

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COMPUTER LITERACY: THE NEW MATH OF THE 80'S

Daniel D. McCracken

A lot of people seem to believe that "everybody" needs "computer literacy." The proponents seldom offer a definition of what computer literacy is, but all too often the upshot is a programming course, most often in Basic. The reasons given for this sudden need for universal computer literacy are similarly vague. Sometimes it's vocational: there will be lots of jobs working with computers, and every other field will be impacted by them, so "everybody" needs to know . . . well, *something*. Other times the reason is that computers will be so pervasive that it is important the man in the street not be afraid of them. And sometimes the argument seems to be that "everybody" needs to know about computers because so many policy decisions (privacy, employment, program copyrightability, etc.) will involve computers.

I'm extremely dubious. I don't think the vocational argument holds water at all, not if the response is a programming course. The fear argument boils down to consumerism training, which should be left to the people who stand to benefit, like the banks. The argument from the needs of public policy impresses me most, but that applies to a small minority of college students, not "everybody," and I have severe doubts that the average computer literacy course goes very far to meet that need.

I also look to historical precedents, where I see no other attempt to educate the entire populace about new technology having (so far) much greater impact on people's everyday lives than computers, such as automobiles and TV. The only direct precedent was the New Math fad a couple of decades ago, which was pushed for many of the same reasons now being advanced for computer literacy, and which sank with hardly a trace when those arguments turned out to be mostly empty.

In a word, I see computer literacy--according to the current *de facto* definition--as the New Math of the 1980's. And if under a more rational definition there really is something there, let's be sure we have the resources (people, money, software, courseware) to carry it off effectively before rushing into action.

The Alleged Reasons Don't Bear Close Examination

1. The vocational argument just doesn't hold up, not if the response to it is a programming course. Programmers currently make up perhaps 0.5% of the work force. (Job duties match job titles so poorly that it is hard to tell.) Can you imagine that ever being 10%? 5%? Even 2%? Two percent would be two million programmers; if that many are really needed, it is a terrible indictment of the applications development process, which won't be solved by throwing more programmers at it. And if there is that much backed-up demand for computer applications, then the solution will most likely be to move beyond today's conventional programming languages anyway. The same company that has the bulk of the computers in schools makes vast advertising capital

of the fact that you don't have to know much of anything about how computers work in order to use their products! (And they are right about that, of course. The most signification trend in the whole computer applications arena is precisely the rapid movement away from developing applications with today's programming languages.)

Why should all school children be exposed to programming when only a tiny fraction have any realistic hope of programming careers?

From a vocational standpoint, the overwhelming importance of computing--which I don't deny, of course--will presumably create the need for far more data entry clerks than programmers, and yet I hear of no increased emphasis on typing. There will probably be more computer operators than programmers, too, and many of them today don't know programming *and don't need to*. If they do know programming, it's probably because they got suckered in by advertising from a for-profit data processing school, only to discover that they weren't qualified for jobs as programmers.

It is of course true that knowledge of computing has vocational value for some fraction of the population, and I have no objection to training at the high school level for such people, any more than I object to physics and chemistry for future engineers and scientists. I wouldn't even mind if a lot of future lawyers and corporation presidents and legislators knew more about physics and chemistry. But then when I hear that only about 10% of the high school population in fact takes physics, at the same time that schools are revising budgets to buy computers, I have to ask myself if "computer science" as taught at the high school level is really more important than physics. And I ask that question whether we are talking about future engineers or future Congress members.

Remember: you ordinarily can't just *add* something to the curriculum; you have to *replace* something. Just what is a half-baked Basic course more important *than*? Wouldn't you really trade that kind of kindergarten knowledge of computers for the ability to write a coherent paragraph?

2. The fear-of-computers argument seems to be advanced mostly by people who stand to make money if the public would accept their services more readily. I say: let them solve their own problems.

Sometimes this argument is advanced in the context of fear of abuse of power by government, the dangers of overdependence on computers, etc. I happen to think that many of those fears are justified. If computer literacy has a place here, it is in the public policy area; it is certainly not the proper function of a computer literacy course to pour on some soothing syrup to the effect that there is nothing to worry about.

3. The argument from the needs of public policy is more interesting, but with limits and doubts. First of all, it surely doesn't apply to "everybody," at least not with the same force. The need to "know something about computers" is not the same for a future high school

history teacher, say, or a future town councilperson, as it is for the 40% of the population that doesn't graduate from high school, or for the high school graduates who will be "using computers" by sitting 40 hours a week at an airline reservation terminal.

4. Even if it is granted that some people, if not all, should "know something about computers," it isn't at all clear to me what they should know, or whether we know how to teach that. The average computer literacy course seems to turn out to involve some programming, usually in Basic, plus some rather diffuse discussions of the impact on employment (nobody knows much about this, it seems), some talk about privacy (there are arguments on both sides, it turns out, so the fair-minded teacher ends up handing out some mush), and a collection of other vague generalities depending on the interests and background of the teacher.

It is not at all clear to me that, even if the need is granted, this kind of course meets it. I just don't see how knowing the syntax of the FOR-NEXT construct (or even WHILE-DO if Pascal is used) serves the needs of either the future data entry clerk or the future Supreme Court Justice. If one accepts the wisdom of the epigram attributed to Albert Einstein, "Education is what you remember after you've forgotten the facts," just exactly what do you hope will be the residue after the syntax rules have been long forgotten?

5. All of this presupposes a competent teacher. I have doubts here, too. I read a report of a demonstration course run by a superteacher with a selected class of highly motivated students, and I tremble to think what will come out the other end when "computer literacy" is taught by a seventh grade science teacher who has never had calculus and who is currently taking his or her first in-service course in computing. Most such teachers can indeed keep a step ahead of the students on the syntax of some low level programming language, but what hope is there that such a person can impart any of the perspective and interpretation that is presumably the main reason for teaching the subject?

(I'm not making this up, you know. The New York Times, reporting on a relatively wealthy suburban school district that planned to issue $320,000 in bonds to pay for computer hardware, told of the math teacher who had taken a two-day "computer software course" given by the school district, and one programming course at a local college. She was quoted as saying that she felt she had to keep one step ahead of the children. A noble goal! I wonder if she succeeded?)

6. Other new technologies have had great impact on society, and yet we have seen no need for the entire population to understand their technical basis. Take automobiles, for instance.

Cars are of tremendous importance in everyday life, the national economy, and all kinds of public policy issues. Most people will spend *far* more time and money on cars than computers, ever. A person starting driving today has a 50% chance of being seriously enough injured in a car accident during a lifetime to require hospitalization, and one chance in 50 of being killed. Cars created our suburbs (an essentially irreversible process), and created much of today's global economics and politics, including the chance of war over petroleum. That all adds up to a matter of great importance, by any measure I can think of.

And so what do we do about it? Teach every citizen what a compression ratio is, or what "spark advance" means, or how a differential works? Of course not. I venture that most drivers couldn't give you anything vaguely approximating an explanation of what a differential is, or how it works, or even where it is. (Do *you* know for sure what a differential is? Could you point out its location on your front-wheel drive car? I couldn't.)

And I say: *so what*? Staying alive through 50 years of driving does not depend on that kind of knowledge, nor does avoiding global war as the oil runs out.

7. Computer literacy is often advocated by people with an obvious axe to grind and negligible knowledge of computing or education. Computer hardware vendors should admit that they are in business to make money, not to Improve Society. (With apologies to the late Fred Allen, all the knowledge of computing to be found in the average computer store salesman would fit nicely in the navel of a flea, with room left over for three caraway seeds and the manager's total knowledge of education.) In Joseph Weizenbaum's memorable phrase, computer illiteracy is a disease invented to market the cure.

8. The closest historical precedent I can think of was the New Math. If I need remind you, for ten years or so millions of kids learned about sets, Boolean algebra, Cartesian products, commutativity, and all that--plus binary arithmetic. I love the binary arithmetic part: that was defended on the grounds that That's How Computers Do It, and everybody was going to have to know about computers.

And what came of it all? At the risk of overgeneralization, I venture to reply that it turned out 98% of the population has absolutely no need to know about Cartesian products and commutativity, that even those of us who spend our careers working with computers have precious little need to know more than the absolute basics of binary arithmetic, and that in the process the schools forgot to teach ordinary arithmetic. (I'm not talking about the demise of the ability to do long division; hand calculators probably have eliminated the need for most of that. I'm talking about the bank clerk who uses a calculator to divide by 100--*and gets it wrong.*)

It seems to me that computer literacy is being advanced for reasons astonishingly reminiscent of the arguments for the New Math. I predict that, unless computer literacy is nipped in the bud as I hope it will be, in about 10 or 20 years the two experiments will appear equally foolish.

Perhaps I should take a longer, more philosophical, view. Perhaps an educational fad every ten years or so is inevitable, and this one may do less damage than some. My mother, if she were alive today, would probably tell me that New Math and Computer Literacy can't hold a candle--for long-term damage done--to the decades-long banishment of phonics in teaching reading.

My Position

Let me try to be specific about what I'm attacking, and then end on a more positive note.

I'm attacking the notion that "everybody" needs to know something about computers, and I'm attacking the seemingly unchallenged assumption that those who do need to know something about computers are automatically best served by learning a smattering of programming. I have no quarrel with the study of computer science as a challenging intellectual discipline or as a vocation, nor with short exploratory courses for students of any age who think they might be interested, nor with elective college courses for non-majors. But I don't understand what defense can be made for having all students--at whatever level--take a required course in which they write a tic-tac-toe program and a program to find all the primes less than 100, and in which they are spoon-fed some pabulum about societal impact. In other words, I don't see the point of teaching everybody a snippet of programming. *Especially* not today's most elementary programming languages, which will be about as relevant ten years from now as that fabulous binary arithmetic in the New Math turned out to be.

And I *really* want to attack whatever forces have led a frighteningly large fraction of today's high school students to think that computer science is the way to go. My concern is based on the report that 10% of the students taking the SAT's a year and a half ago indicated a plan to study computer science in college. If some of that mania has mercifully died down since then, I can be less concerned, of course. But if it has not, *somebody is in trouble*. If that many students actually showed up at the computer science doorsteps, we would have absolutely no way to teach them. We're overwhelmed as it is. But if by some miracle they could get educations, there is zero chance that they would all find work in computer science. The world simply does not need that many computer scientists. To allow so many students to continue in such a delusion is cruel and irresponsible.

Let me try to indicate what should be done instead, by relating three of my own educational experiences.

Most of what I know about meteorology was gained in the course of obtaining a Boy Scout Merit Badge in the subject. To get it, I had to do some book study, I had to make weather observations for a month, I had to write a report, and I had to pass an exam. In the roughly 40 years since that time I have read some more books and learned some more physics, but the foundation was laid in obtaining that Merit Badge. My point, for the purposes of this paper: it was optional, and it required substantive work on the subject matter, appropriate to my age. As a result, I learned something that has stayed with me, and which I appreciate every time I plan an activity that depends on the weather.

Second experience. As a ninth grader I took a course in journalism. The main thing that happened there was that we had to *do it*. We put out the school newspaper, we had to write articles on a wide variety of subjects, we criticized each others' work, and we got a lot of guidance from a teacher who could write and who could teach. Since I have spent most of my adult life writing, I suppose it's obvious that the course had a profound impact on me. The point: it was optional, and I had to do a lot of work in the subject matter.

Third experience. As a college student I was required to take one course in biology. To my subsequent regret, I elected a survey course. It was taught, as it happens, by a young woman who knew her subject thoroughly, enjoyed teaching, and presented the material with enthusiasm. But there was no laboratory work. I could memorize things better in those days than now, and had no difficulty getting an A in the course, but I remember essentially nothing from it. Today I know less about biology than about any other subject I studied in college, and I regret the lost opportunity at least once a week. The point: it was a required course outside my major, and I did not do any substantive work in the subject matter.

Define Your Goals!

Yes, computers *are* important. They offer vocational opportunities for some, and have great societal impact. But, just as we don't require all drivers to know what a differential is, there is no need to teach all students how to program. A better case could be made for requiring all students to know how to use word processing, in which a computer serves as a tool for doing other things, but at this point we don't even require all students to know how to type.

I suggest that "computer literacy" be put on hold, unless and until we find a meaningful definition of it, defensible goals, and achievable means of reaching those goals. Nothing of the sort being in sight, I further suggest that we concentrate on developing elective programs having solid technical content appropriate to the school level.

Now, if you have your definition of computer literacy that makes sense to you and which is not subject to the criticisms expressed here, then I wish you well and I'd like to hear more about it. As a school board member I was tremendously moved to see what can be done by dedicated teachers using computers to reach into the world of autistic children. I am delighted with the success stories about teaching reading and writing to young children with the help of carefully designed computer programs. I think all college students should have access to word processing as an aid to better writing in all their courses.

Let me simply offer three comments. First, this stuff isn't cheap. You should not be offended if asked to cost-justify the use of computers. Second, the hardware is the merest beginning; without courseware you are nowhere, and from what I hear most courseware ranges from poor to terrible. Just finding the precious few that are good can take a lot of time and effort, which isn't free either. Third, even if you can justify the expense and somehow find the good courseware if it exists in your area, nothing teaches itself. The classroom teacher is still the heart, soul, and muscle of the educational experience; all this neat new technology may make the learning more effective, but it doesn't make the teaching any easier.

Summary

On our present course, we are going to waste a decade or more, a lot of money, and an priceless opportunity to do more useful things—on a venture with goals that I do not believe even its proponents have clearly defined. The attitude seems to be, "The Computers Are Coming! Don't just stand there! DO SOMETHING!" Well, sure, the computers are coming. They will affect our lives, and the lives of our children and our grandchildren, in ways more profound than any previous technological innovation. But, much as it hurts me to say it considering that I write programming books for a living, I don't understand how we can prepare for that future effectively by requiring all students to take kindergarten-level training in the way computers are currently being programmed.

COMPUTER SCIENCE IN THE SECONDARY SCHOOLS

Chris Brantley

There exists in the secondary school today a debate over the roll of computer science education. To many teachers of the subject it has been a truely rewarding experience to master this new technology and then share their own learning experiences with their students. To many other teachers and administrators the study of computer science has been an extra which has gained acceptance as a vocational skill somehow related to the math department. To others it has become a basic skill in which all students should be enrolled for at least one course to ensure survival in our technological society. To many parents computer science is viewed, due to certain T.V. commercials, as necessary study for success in college. There exists, in today's secondary schools, the need to clarify the need for computer science education and define its place in our curriculum. It is my contention that computer science education offers a unique opportunity for students to develop the skills in problem analysis and refinement to which many articles in today's popular press point as the greatest deficiency in our shool's.

We read and hear references to the inability of our graduates to apply their learning to tasks given to them in the workplace. We are told by studies of the future that workers will need the ability to adapt quickly to new job situations and that the primary need is for people trained to think through problems and develop possible solutions in an organized way. Many corporations have moved to lengthy interviews which provide job applicants with the opportunity to demonstrate their ability to think through and deal with problems, rather than short interviews which show the applicants mastery of the knowledge base needed for the position.

Most of the curriculum in the secondary school today centers on the development of this knowledge base and its application in a relatively small set of problems. For example, the ultimate course in most high school science departments is physics. Physics teachers strive to get their students to apply the scientific method to prove the laws of physics and then to apply those laws to predict the outcome of future controled experiments. In this endeavor students must identify a problem which is testable. Most students, if left alone, will develop problem statements which are too broad to be tested. Therefore, textbooks refine these broad problems into workable ones for the student. This is fine for the student if the goal is the development of the knowledge base of physical laws but it does not develop in the student the ability to refine problems into workable solutions.

Another example might be seen in advanced math courses. The focus here is the development of a vast repetoire of techniques for manipulating numbers and variables in order to model real world problems. Again, as in the study of physics, the problems on which students work are narrowly defined by the text to facilitate the development of this repetoire of number manipulation skills. Again, this is as it should be because the goal is the development of those skills. How many of us can recall in our study of math, though, that magical day when some masterful teacher was able to help the class analyze a real world problem which a student brought with them to class and see that these skills really did work on something other than the seemingly contrived problems in the book? I maintain that these seemingly contrived problems are the best we can do in the courses mentioned above due to the massive knowledge bases needed in these disciplines.

The reason I defend computer science curriculum in the secondary school is that computer science requires a relatively small knowledge base to enable the teaching of problem analysis and refinement. Students can be introduced to task refinement techniques after less than an hour of instruction in the LOGO language for example. Any computer science teacher can tell stories of students whom they have had in class who have learned enough of this small knowledge base from magazines, friends, and playing with their home computer, to write programs but, because these students have developed no problem analysis skills, the programs they write are filled with logic and structural errors. The justification for computer science as a curriculum in our secondary schools is that it provides a highly motivational vehicle with which to teach problem solving skills.

Computer science curriculums have been evolving during the past five years from additions to the math curriculum (primarily instruction in programming languages) in two directions. One is the use of the computer and existing computer programs to solve real word data and information management problems. The other is into the development of computer programs through the use of basic structures of task accomplishment which are independent of computer language. While both of these developing curriculums provide numerous opportunities to develop problem analysis skills, it is the second that I will focus on today.

I have had many conversations with other curriculum vice principals concerned with the place of computer programming classes in their curriculum. There is concern that computer programming is a vocational skill which will not be needed by 90% of the population. There is also concern that this curriculum tends to take students away from some of the other, more traditional and proven, curriculum areas. I will attempt, in the rest of this paper, to present a view of a first course in computer science with a central focus of providing a set of thinking skills which require the use of higher level cognative skills never reached in curriculum areas stressing the development of a knowledge base. I maintain that these skills deserve a place in our curriculum.

This course description must begin with the curriculum fundamentals which I feel must form the course's base in order for it to deserve a place in our curriculum. These fundamentals fit into two categories. They are 1) the division of complex problems or tasks into smaller, more manageable, modules, and 2) the development of algorithms to accomplish these modules which use the three logical structures of sequential steps, branching, and repetition.

The first of these basic curriculum pieces can be stated as the divide and conquer strategy. Students must learn the skills of identifying the manageable pieces of a large task which, if accomplished, would accomplish that task. Skills such as step-wise-refinement must be the basic tool which students use to develop solutions to program requirements. They must see that an algorithm which they used to perform a small task in one situation quite often is useful in many other seemingly different programs.

The second piece must emphasize the work of E. W. Dijkstra and allow students to see that any algorithm must use as its fundamental units these structures...

```
Sequential
   Example
   Get a number
   Get another number
   Add them
   Tell the user the sum

Decision
    -If..Then
        Example
        If Hours Worked is greater than 40 then
             calculate overtime pay
    -If..Then..Else
        Example
        If Guess is greater than Number then
           tell them to guess lower
        Else
           tell them to guess higher
    -Case
        Example
        Case Answer of
           A: Do something
           B: Do something else
           C: Do yet another thing
           D: Or another
```

```
Repetition
    -Counting
        Example
        For each degree from 0 to 360
           Print the  degree,  its  sine  and  its cosine
    -Doing  a  task - checking the need to repeat - and doing
     it again
        Example
        Repeat
           Do something
           Tally
        Until the Tally is 250
    -Checking the need to do a task - doing  it  -  and  then
     checking the need to repeat
        Example
        While the Principal is greater than the Payment
           Calculate Interest
           Find Difference between Interest and Payment
           Deduct Difference from Principal
           Tally Months
        Print number of Months and Principal when done
```

With these structures any task can be described. Computer science course must stress the use of these structures and their translation into a computer language so that a computer can accomplish the tasks described. Notice that the language becomes a distant second in importance in this computer science curriculum. Analyzing and describing the task is the majority of the curriculum, the coding of the resulting solution is simply a verification for the student that their solution works.

What we see hear is a new focus for our beginning computer science classes in the secondary schools. To this point our introductory courses focused on the use of a computer language. The course taught the key words of some some language (usually BASIC) and the students put those keywords together any way they could figure to produce programs that ran. Programs that ran were the ultimate. Little consideration was given to the way in which the program was put together or the correctness of the algorithm. If the teacher caused the program to "blow up" by inputting some data which the student had not anticipated, the typical response was for the student to go back into the program and patch it together however they could. This usually required the use of numerous GOTO statements and resulted in what has come to be known as spaghetti code. Teachers typically graded programs on whether they ran or not simply because attempting to read these programs required incredible amounts of time and usually resulted in a high frustration level. The type of programmer which these courses have produced has had little success in university computer science curriculums due, I think, to the fact that they have been not be taught the fundamental tools of a computer programmer, which are the structures with which algorithms are built and techniques to analyze complicated processes or tasks. They have been, in essence, handed the lumber to build a house but have not been taught how to use the tools of a carpenter or how houses are put together. My experience tells me that students who are taught, early on in their computer education, the structures of computer programs and the techniques of task refinement are more adaptable to new computer languages and programming challenges.

With this premise in mind let us take a look at a possible curriculum for use as a beginning computer science course at the secondary level. This is a course which I have taught. It does not matter what computer language is chosen for this course. I have taught pieces of the course using LOGO and then switched for other pieces of the course, with the same students, to BASIC and PASCAL. Some of the projects were never entered into a computer but were simply pseudocoded and handed in in that form. All projects are pseudocoded first in a form that lends itself to task analysis and refinement. The entire focus from day one is to learn the basic structures of computer languages, their uses, and their interaction with one another. Data manipulation comes only at the end of the first course, after students can write sound algorithms. Here then is a course for your school to begin with, add to, delete from, and refine to the point where your students are learning to think through problems rather than trial and error their way to computer programs.

COMPUTER SCIENCE I

Computer Science I is designed to introduce the student to the field of computer science. The seven basic structures used in the development of computer programs form the core of the course. Students will use these structures to write computer programs in the BASIC language, then use a computer to determine the correctness of their programs. The course encourages creative thinking skills such as task analysis, refinement of a problem, divergent thinking, group problem solving, and clarity of documentation.

Major topics covered by the course include Operation of a Computer, Linear Algorithms, Looping Algorithms, Branching Algorithms, Data Manipulation (Variables and Arrays of Variables), and Sequential File Manipulations.

COURSE OBJECTIVES

OBJECTIVE I.1 - The students will develop programs which reflect modularized design.

OBJECTIVE I.2 - The students will develop programs which utilize linear algorithms.

OBJECTIVE I.3 - The students will develop programs which utilize the three branching constructs: If..Then, If..Then..Else, and Case.

OBJECTIVE I.4 - The students will develop programs which utilize the three looping contructs: Do..Check, Check..Do, and Iteration.

OBJECTIVE I.5 - The students make effective use of variables and single dimensioned arrays.

OBJECTIVE II.1 - The students will either include a variable chart or use variable names which allow the reader to determine their use without difficulty.

OBJECTIVE II.2 - The students will either include a program description within the code of their programs or include such a description in the external documentation.

OBJECTIVE II.3 - The students will write program code which includes remarks to enhance the readability of that code as well as show the modularization.

OBJECTIVE II.4 - The students will develop external documentation showing the design of their programs in either Warnier-Orr, Flowchart, or Pseudocode form.

OBJECTIVE III.1 - The students will write programs which include and introduction to the user explaining the use of the program.

OBJECTIVE III.2 - The students will write computer programs which include prompts for user input which delineates the acceptable parameters for that input.

OBJECTIVE III.3 - The students will write at least one program in which all input is screened for acceptability. Erroneous input will be dealt with through prompting the user and reentry.

OBJECTIVE III.4 - The students will write computer programs which provide the user with menus of their options.

OBJECTIVE IV.1 - The students will develop computer programs which utilize the computers ability to "number crunch."

OBJECTIVE IV.2 - The students will appreciate the complexity of the computer programs which perform the popular applications of the computer today such as computer games, word processors, spreadsheets, and data base managers.

OBJECTIVE IV.3 - The students will be aware of the uses to which computers are put by the businesses and government agencies in our area.

OBJECTIVE IV.4 - The students will be aware of the danger of loss of information inherent in computer use due to power loss and magnetic fields.

OBJECTIVE IV.5 - The students will appreciate that computers do only what they are programmed to do.

OBJECTIVE IV.6 - The students will appreciate the dangers to free thought inherent in the computer being viewed as a solution to society's problems.

OBJECTIVE V.1 - The students will explain the role of the C.P.U.'s arithmetic logic and control units, memory, input device, output device, and storage device (external memory).

OBJECTIVE V.2 - The student will recognize the major components of various computer systems as C.P.U.'s, input, output, and storage devices.

OBJECTIVE VI.1 - Students will develop their own algorithms for computer programs.

OBJECTIVE VI.2 - Students will recognize that the same outcome can be obtained through more than one algorithm.

OBJECTIVE VII.1 - The students will develop at least one program with only a verbal description of what it is to do. They will utilize questioning strategies to determine the specifics of the program requirements.

OBJECTIVE VII.2 - The students will work on at least one project developed through the team programming approach.

COURSE OUTLINE

Concepts or Constructs (days)

General Computer Operations (2-3)
- Startup or Logon
- Cataloging the Disk
- Loading Programs
- Editing Programs
- Saving Programs

Components of Computer Systems (2-3)
- CPU (ALU and Control Unit)
- Input/Output
- Memory
- Storage

History, Current Events, and Trends of Computers in Society (5)
- Key figures and hardware in history of computers
- Current state of computers in society (hardware, software, and impact)
- Future possibilities and liabilities of computers in our society

- Linear Algorithms (8)
    - Output
    - Input
    - Variables
        - Initialization
        - Assignment
            - Order of operations
            - Complex expressions
            - Intrinsic functions

- Modularization and Internal Documentation (3)
    - Refinement into procedures
    - Naming variables or Var. Chart
    - Writing remarks for
        - Program Heading
        - Procedure Headings

- Iterative Loops (10)
    - FOR..NEXT loops
        - Indentation of control structure
    - Output of tables
        - Integer, Floating Pt., Alpha/Numeric, Exponential, Literal
        - Headings

- Internal Workings (3)
    - Binary number system
    - Machine language vs. high level
        - Interpreters
        - Compilers

- If..Then (5)
    - Proper uses

- Program Development (5)
    - Pencil and paper accomplishment of the task to be programed
    - Pseudocode or Flowchart
    - Write Program
    - Dry run
    - Enter Program

- Check..Do and Do..Check Loops (10)
    - Proper uses
    - Incrementation
    - Summation
    - Input validation

- Debugging Strategies (3)
    - Dry run
    - Breaking program to examine values of variables
    - Addition of print statements
    - Use of modularization in location of program "bugs"

- If..Then..Else (10)
  - Proper use
  - Binary search
  - Boolean variables

- Case (3)
  - Proper use
  - Menus

- Single Dimensioned Arrays (10)
  - Dimensioning
  - Input loops
  - Output loops

- Sorting (5)
  - Introduction to sorting algorithms

- Sequential Files (5)
  - Input
  - Output

As you look through the course objectives and topic outline you see that the structures of computer programs do form the content of the course. The language in which the algorithms are coded is up to the discretion of the instructor. It is paramount, however, that the process of algorithm development be the focus due to the poor habits developed by students who are left on their own to "figure out" how to program a computer given only the key words and time.

If we, as computer science instructors, continue to allow the style of computer programming instruction which has been the norm to continue, computer programming instruction in the secondary school should cease. It provides nothing to the student which is enduring. The language which we teach them will give way to a new language. The computer on which we teach them will give way to a new computer. The knowledge which should form the foundation of the course is the process of problem analysis just as the foundation of a good physics course is the scientific method. We, like good physics instructors, must concentrate our efforts on moving the cognitive level of our students into the higher processes of analysis and synthesis. Only then will the computer science instruction begin to fill a void in our educational system and earn its place as another discipline which deserves to be taught in the public school.

THE HUMAN MEMORY MECHANISM AND ITS PERIPHERALS

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A Summary of the Presentation

Recent research discoveries and technological developments have vastly increased our understanding of the organization and development of the human brain, and scientists are approaching an understanding of memory, perhaps the most complex and elusive of all cognitive systems. A parallel rapid expansion is occurring in the development of memories the human brain locates outside its skull -- the reference books, notepads, schedules, contracts, audio/video tape recorders, calculators, computers, databases etc. that help us maintain contact with external sources of information that our brain can't effectively store (or doesn't choose to store) within itself.

Knowing that cognitive processes function through the manufacture and release of neural chemicals that affect the permeability of the membranes of other neurons is a far cry from knowing why half the students in a class missed a given item on a recall test, or why a person can remember a trivial childhood event but not the location of an important file used yesterday. Still, memory, its handmaiden learning, and their technological extensions are so important to the educative process that educators ought to monitor current theory and research for new developments that could affect the teaching and learning process. Further, meta-cognition (thinking about thinking processes) should become a major curricular focus. Information-processing has now become a dominant social function, and today's students must understand its dynamics.

Human Memory Mechanisms

Memory mechanisms appear to be more localized and specialized than previously thought, and probably involve physical changes in the neural network -- changes that establish and enhance preferred neural communicative routes. These changes could involve (1) the rate at which neurons fire in the memory sequence, (2) the number and type of neurotransmitters that are released, (3) the number, characteristics, and locations of available receptor sites on a target neuron, or (4) some dynamic combination of the above.

The process of remembering begins within our limited-capacity sensory and short-term memory systems, which briefly hold the incoming sensory information, and especially that which captures our attention. It's possible to hold such information longer within memory feedback loops that require continued conscious attention or verbalization, but almost any distraction will erase it. For example, the memory trace of an unfamiliar phone number undergoes electrochemical disintegration within seconds if we don't dial it or consciously retain it.

When such transitory information is no longer needed, we fortunately forget it -- in this case, to be replaced immediately with the sensory input that now competes for our attention, the voice answering the phone.

Important and emotion-laden information that the mind chooses to retain longer is entered and consolidated within two separate but interrelated long-term educationally significant memory systems that develop some type of physical manifestation of memories. The **declarative** system processes all the explicit who/what/where/when/why facts and symbols that are relatively easy to learn, and to forget -- a car's location and license number. The **procedural** system processes automatic motor and problem solving skills that are relatively difficult to learn and to forget -- how to drive the car.

Think of **short-term memory** (or the working brain) as the collection of things that arrive on your desk and compete briefly for your attention. Consider **long-term memory** to be everything you've consciously organized within your files for later use, or that you processed through automatic established procedures, and **forgetting** as all the things you processed and then threw in the wastebasket -- or as information hopelessly lost in your files.

Declarative memory. The fingersize hippocampus, located within the temporal lobes, plays a major role (analagous to a telephone switchboard) in consolidating and connecting factual declarative memories that are probably stored in networks of neurons in the vast storage area of the neocortex, the deeply folded top layer of the human brain that occupies about 85% of its mass. The need for efficient storage and retrieval of all the labels and locations that keep us in touch with our environment suggests that we should consciously store declarative material at multiple sensory and logical levels, much as a business would list its phone number under several phone book classifications.

The hippocampus and nearby amygdala appear to work together to continually compare incoming sensory data with our memory's vast store of related prior experience. They then efficiently direct the limited-capacity working brain to ignore things that occur within normal predictable limits, and to attend to unusual, intense, and emotion-laden stimuli -- potential problem areas that require conscious attention.

We tend to lose our memory of specific examples of recurring information (e.g.,holidays, students) as we incorporate earlier information into the more recent. Thus, over time, we develop a general memory of Christmas celebrations, students, and so on; and tend to remember only the first, the last, and those that deviated significantly. This important consolidation of neural networks reduces and simplifies the information our memory must hold. Unfortunately, it can also lead to overgeneralizations, bigotry, forgetting the names of people, and other assorted memory lapses.

Procedural memory. The cerebellum, the large bump at the lower back of the head, appears to be the place where important procedural skill sequences are procesed. The cerebellum could be considered the brain's automatic pilot, in that routine actions such as walking, talking, typing, and bicycling are carried out almost unconsciously -- thus freeing the limited-capacity working brain to focus on novel and complex things that require conscious attention.

Mastery of a procedure or skill often begins at the declarative memory level. We begin by consciously learning and executing the appropriate rules, sequences, and terminology. For example, we consciously memorize the entire typewriter keyboard. Continued successful practice will move the process into the procedural memory and automatic proficiency -- we lose our conscious memory of the keyboard, but improve our typing skills. Procedural memories at the expert level often include a clear, overall mental representation of the skill that permits many individual actions to be processed as a single behavioral unit, and successful improvisation to occur.

It's difficult to recall a skill except through its execution. It's also difficult to explain or discuss a skill. Skilled performers often so internalize their skills that they con't effectively verbalize them or explain them to others. The best athletes don't necessarily become the most successful coaches. Effective teaching may well arise out of a teacher's ability to make smooth and effective transitions between the declarative and procedural thought processes -- to create clear explanations and powerful metaphors, to model effectively.

The declarative and procedural systems combine marvelously to enhance human life. Our ability to consciously analyze and label skill sequences permits us to develop valued skills at the expert level. Our ability to execute most skill behaviors automatically frees our conscious brain to explore and remember much of the complex social environment in which we live. Our ability to create complex external memory technologies permits us to store information in both massive cathedrals and minute chips, to pass information from generation to generation, to bounce it off satellites to all parts of the earth, to so to unify the human experience.

Curricular Challenges

Memory research is truly at the edge of exciting developments that will profoundly affect the teaching profession in the years ahead. Recent research suggests that a continually stimulating classroom environment can enhance the development of connections among related brain areas, and this in turn positively affects cognitive development. The following four areas pose special current curricular challenges:

1. What knowledge and skills should students commit to memory, and what should they process through efficient external memory technologies (e.g., calculators, word processors with spelling checkers)?

2. How can we help students move from the memorization of random facts to the understanding of useful interrelated concepts?

3. How can we teach students to use their memory effectively in problem solving?

4. How can we use neuroscience research to enhance the effectiveness of students' memory?

The above material is adapted from: Robert Sylwester, "Research on Memory: Major Discoveries, Major Educational Challenges" EDUCATIONAL LEADERSHIP (April, 1985. pages 69-75).
Additional duplicated explanatory material will be distributed at the presentation.

VIDEO DISK INSTRUCTION

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One of the most potent technologies available to educators is the video disk. One side of a laser disk can project 54,000 different still frame screens, making it the world's most efficient slide projector. If the frames are presented quickly, motion sequences are produced. The teacher can play the disk forward and backward at different speeds, freeze the action for a moment while making a comment, or leave the image on the screen for the entire period. If a different portion of the disk is needed for class discussion, the disk player can jump to another portion of the disk in a few seconds. The ability to quickly jump from place to place is called random access. Moving from place to place on video tape is much slower.

The potential of video disk instruction is limited only by the dynamics of the video sequences (Morris, 1984), the simplicity and power of the instructional content (O'Loughlin & White, 1982), and the presence of a mastery learning management plan (Block, 1971). A well conceived and executed video disk instructional system would both motivate students and increase their understanding and mastery of the subject area content (Sunderson, Baillie & Olsen, 1984). Video disk instruction can include drill and practice, tutorials, and simulations.

Prevalence of Video Disk Technology

For all the advantages of the video disk, the technology is only slowly beginning to appear in schools. Stereotypes about how the technology can be used may account for this slow emergence. Most educators hook a disk player to a computer and provide instruction for a single user. Limited user access makes video disk technology too expensive for widespread public school adoption. Most schools cannot afford the hardware and software for video disk if only a few students can use the system each day.

However, breaking the stereotype that disk players must be hooked to a computer and used with one student at a time makes disk technology affordable. Presenting video disk instruction to an entire classroom, not to a single student, is cost efficient. Then 25 or more students at a time benefit from the disk technology. Moreover, the teacher maintains a central role in the instructional process, deciding when to review or to elaborate content presented on the disk. Entire class instruction, directed by a teacher, also makes it feasible for a teacher to use a video disk course as a primary means of presenting course content. An example of the potential of video disk technology is a system now under development called Core Concepts, a system which brings together video disk technology, instructional design, and mastery learning procedures to address a central challenge in American education--math and science instruction in high schools and colleges. Math and science teachers are too aware of the trade-offs between "finishing the book" and making sure the students come away with a basic understanding of the central concept of the course. The growth of textbooks over the last five years makes compromise all the more difficult. The appeal of video disk instruction in Core Concepts is that it can compellingly convey what's most important to learn.

Dynamic Video

The advantage of dynamic video sequences are apparent. A textbook diagram of RNA's role in assembling proteins does not as clearly convey the process as would a video sequence of the process in operation. Video can also highlight crucial events, like inclusion of the wrong amino acid in an RNA chain. The integration of video and audio, to give explanations while phenomena are being shown, or to ask questions, makes possible realistic instruction through the disk medium.

Instructional Design

The dynamics of video ("a motion sequence is worth ten textbook pictures") allows concepts to be conveyed in a relatively simple fashion. The notion of economy (and power) in instructional design came from Bruner's Toward a Theory of Instruction (1966). Economy comes in the simplicity of an analysis for portraying knowledge. Power refers to the generalizability of an analysis, the degress to which the analysis applies to many different examples. Economy and power are important because they provide a lens for transforming the growing information in science into more manageable chunks that are relatively easy to understand and that have great explanatory power. An example from the Core Concepts physical science program is harmonic motion. Students are first taught about generating and restoring forces in pendulum.

A generating force (a push) sets the pendulum in motion (from position B in Figure 1). As the pendulum rises, a restoring force (gravity) slows the pendulum and momentarily stops it (position A in Figure 2). The pendulum then falls back, overshooting its starting point (position B) and rises on the other side, stopping at position C. The cycle then repeats itself--the pendulum falls back, overshoots, rises, stops, falls back, overshoots, etc. In short, the pendulum forms a system to which energy is added (a generating force) and that energy is then transformed by a restoring force.

The economy of this explanation of the operation of a pendulum can be compellingly conveyed with a video disk, particularly with freeze frames and slow motion. The economy also sets the stage for the power of the instructional design. Harmonic motion, with a generative and a restoring force, is then used to explain water waves, electricity and cloud movement. (See Figure 2.) By using a single relatively simple model for harmonic motion, students can fairly readily come to understand one of the core concepts that underlies the seemingly unrelated phenomena of water waves, electricity, and cloud movement.

Power in instructional design not only shows relationships among seemingly different topics, but also reviews core concepts. Each time important concepts, like generating and restoring forces, are applied to a new example, these concepts are also reviewed. Thus, power contributes to both generalization and retention.

Mastery Learning Procedures

Dynamic video and well-designed instructional sequences will not ensure adequate learning by the full range of students found in secondary and post-secondary classrooms. The Core Concepts course has numerous check points for evaluating how well students are learning. At each check point, the teacher decides whether enough of the students are performing acceptably on test items. If class performance is deemed satisfactory, the teacher presents the next new segment on the disk. If performance is unsatisfactory, the teacher replays an instructional segment from an earlier disk lesson and then presents practice problems. These problems are presented as still frames (like slides) on the screen. After students work a problem, the next screen, which shows the steps for working the problem, is presented. The teacher presents problems one at a time until reaching the next check point. Depending on how students perform, the teacher either goes on in the lesson or replays a appropriate instructional segment from the disk.

The check points occur at these stages:

1. After each new instructional segment from a lesson. These practice problems serve as an immediate check.

2. Before the beginning of the next lesson. This brief quiz is a one-day delay check.

3. After every fourth lesson. This mastery test is a one-week delay check.

4. At the end of each grading period. This exam is a multi-week delay check.

Immediate checks reveal how well initial learning is progressing. Teachers can quickly review troublesome material, before initial confusions grow unwieldy. Delayed checks measure retention. Having checkpoints at various intervals allows teachers to quickly review skills before serious misconceptions develop. In classes with a wide ability range, the mastery learning systems gives a teacher feedback needed to decide how much additional explaining and practice are needed by the students. This feedback does not eliminate the problems caused by students with heterogeneous skills, but it does allow teachers to react efficiently and effectively to students' errors.

Benefits to Administrators

The primary benefits of a video disk instructional system like _Core Concepts_ have already been discussed:

1. The clarity and motivating capacity of dynamic video.
2. The simplicity and power of the instructional design.
3. The mastery learning procedures.

Some of the capabilities of _Core Concepts_ are particularly relevant to a major administrator concern--staff development. In school districts where, for one reason or another, finding qualified math and science teachers is particularly difficult, the _Core Concepts_ system offers the opportunity to ensure that students receive high quality instruction. In classrooms with qualified instructors, the _Core Concepts_ system can provide vivid, compelling visuals. Experienced teachers build on the video presentation.

In all situations, the full course video disk system could provide a model of important aspects of instructional design and of mastery learning that would be informative for most teachers.

Finally, the frequent check points in the mastery learning procedure also make it relatively easy for administrators to gauge the progress of students in classes taught by reassigned teachers, or by an group of teachers for that matter.

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PROBLEM SOLVING FROM A COMPUTER EDUCATOR'S POINT OF VIEW

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Goals of the Workshop

This is a two hour workshop on problem solving having five main goals.

1. To understand the terms problem and problem situation.
2. To learn to differentiate between relatively formal and relatively informal problems or problem situations.
3. To understand possible roles of computers in problem solving, and especially to understand the idea of a computerizable **EFFECTIVE PROCEDURE.**
4. To understand how an orientation toward computer-assisted problem solving might change the overall curriculum.
5. To develop some ideas on how to make use of your increased knowledge about problem solving.

An Overall Task of Education

The totality of human knowledge can be divided into disciplines such as anthropology, biology, chemistry, etc. Each discipline has its own specialized vocabulary and notation, techniques of inquiry, methods of training, and accumulated knowledge. This means that it takes a reasonable amout of education within a discipline to merely communicate with others within the discipline.

Each discipline has its own specialists who work to increase the accumulated knowledge of the discipline. Generally these specialists are very talented within the discipline, have studied and practiced the discipline for many years, and work long hours. It is hard to master a discipline to a level where one can be a successful teacher and/or researcher. It is not easy to develop new ideas and to expand a well established field of study.

The issue of specialized talent is important. Each human seems to have a unique set of potentials. Howard Gardner has identified seven distinct types or areas of human intelligence, such as linguistic, musical, logical-mathematical, and so on (Gardner, 1984). The people who are at the frontiers of each discipline tend to have considerable "natural talent" within the discipline. This, combined with long and hard work, allows them to master the discipline so they can discover new results and in other ways advance the discipline.

The accumulated knowledge within a single discipline, such as mathematics, may represent the work of tens of thousands of researchers working over many hundreds of years. These researchers have identified key problems within the discipline and have solved many of these problems. They have developed both specific methods for solving specific problems and general methods for attacking problems that have not yet been solved or are not readily identified as falling into the "solved" category.

Our educational system serves as an interface between the accumulated knowledge of the various disciplines and the general interests, needs, and capabilities of each individual growing up in our society. This interface-education task can be approached through three categories of education.

1. General education (such as the three R's) which is basic, interdisciplinary, and assumed to be common to the core of many disciplines. One can identify the strands which extend over several years in a school district's curriculum. These are the basics that are considered sufficiently important to be covered in a spiral approach designed to help all students gain a useful level of knowledge and skills. Most published material assumes the reader will have this basic core knowledge.

2. Specialized training at an introductory level in disciplines considered by our society to be particularly important. The typical school curriculum offers a number of specialized courses at the secondary school level. High school courses in chemistry or psychology are representative of the introductory courses in specialized areas. Note that many other topics, perhaps deemed less important or universal, are taught outside the formal school system. Also, there are considerable differences in what courses are offered in various schools throughout the country.

3. Learning to use the artifacts (tools, devices, aids to problem solving) of one's civilization. Very young children know how to flush a toilet, turn on an electric light or a television set, use a telephone, and use clothing made of synthetic materials. They easily learn to make use of these parts of the accumulated knowledge of a variety of disciplines. The artifacts, or aids to problem solving, of a civilization can be roughly placed on a continuum based on the amount of formal schooling required. The left-most point on the continuum would be artifacts and aids to problem solving requiring no formal schooling to learn to use. Near the right end of the continuum would be those artifacts and aids to problem solving requiring a great deal of formal schooling to learn to use.

Artifacts and aids to problem solving falling near the left end of the continuum particularly interesting because they do not involve formal schooling. Children learn to accomplish a wide variety of tasks (that is, solve a wide variety of problems) through informal instruction, imitation of peers, or trial and error.

Each artifact or aid to problem solving is associated with some problems that humans know how to solve. In that sense, one can also consider a continuum of problems. We clearly are interested in whether (and if so, how) computers might move some problems from the "requires some or a great deal of formal schooling" category into this "requires little or no formal schooling" category.

Each of the three interface-education categories can be examined in light of progress in computers and related technology over the past forty years. Such an examination suggests that our educational system will need to make major changes as computer technology continues to progress and computers become more and more readily available.

Impact of Computers

One can view the computer as the heart of a new discipline which is called computer and information science. Thus, schools need to decide whether this discipline belongs in the multi-year strands that form the core of a general education. Or, should computer and information science be considered as a more specialized discipline, with an introduction being available in high school, and more specialized and deeper courses available only in post secondary education?

That is, to what extent do we place computer and information science into Category 1 and to what extent into Category 2? Many school systems are placing this discipline in both categories, with the strands starting as early as kindergarten or the first grade. Essentially all school systems have placed computer and information science into Category 2, with courses starting at the ninth grade or earlier.

One can also view computers as a new instructional delivery aid. Research suggests this technology can help students learn more, better, faster (Kulik, Bangert, and Williams, 1983). Both the core strands and the introductory courses in specialized disciplines welcome such help.

But most interesting, and most challenging to our formal educational system, is how computers affect the interface betweem a discipline and students. A young person solves the problem of needing light by learning to turn on an electric light. In essence the flipping of a light switch is "telling" a very sophisticated electrical system to "Give me light."

In that same sense, pushing a sequence of buttons on a calculator is telling the calculator to solve a certain category of computational problem. But it requires more formal schooling than that required to learn to flip a light switch. Running a graphics package on a microcomputer and giving it a set of data to graph is telling the computer to solve a particular graphics problem. But this requires more formal schooling than is required to learn to use a calculator. Computers are making it possible for an ever increasing set of problems to be solved by merely telling the problem to a machine. But the "telling" process remains quite sophisticated and requires substantial formal education in many instances. It is this fact that ties together the general ideas and activities of this workshop.

Workshop Activities

I believe all educators list "problem solving" as one of the major goals of education. What is most interesting is to see that each discipline has its own concept of what constitutes a problem and what it means to learn to be a problem solver. Math tends to have the most straightforward definition. I believe the most writing and research on problem solving has been done in this area. But as we explore problem solving in this session, we will have in mind all disciplines. We are looking for unifying themes in problem solving and how computers affect these themes.

=========== FANTASY TRIP ON PROBLEM SOLVING ============

Pick a discipline you have taught of are now teaching. The guided fantasy examines some problems within that discipline and the general nature of problem solving within the discipline. (Note that the detailed guided fantasy is not included in these materials. A fantasy trip is like a guided day dream. It is a "high touch" or quite personalized mode of communication.)

DEBRIEF IN TRIADS: Share the particular area and nature of problem solving that you encountered in your fantasy trip. Pay particular attention to whether "problem solving" means the same thing to each member of your triad.

DEBRIEF IN WHOLE GROUP: Make a list of the problem areas and/or types people in the workshop discussed in their triads. Does problem solving mean math to most people? Note that many people experience math anxiety (Tobias,1978). Thus, if such people tend to equate "problem solving" with math, they likely experience problem solving anxiety. Get workshop participants from non-math disciplines to give examples of problems they have their students study and learn to solve. It is important to stress that every discipline has problems and teaches problem solving.

I find it helpful to distinguish between "formal problem" (which I usually call simply problem) and "problem situation." A formal problem has three distinct and well-defined characteristics, which I call the three Gs. These are the Givens, the Guidelines, and the Goals. If a problem has these characteristics then information on how to solve it can be stored over time and communicated to others. Moreover, group efforts to solve the problem may be possible. But if such communication over time and

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distance is to occur, one must have a precise (formal) definition of the problem. A formal problem must include:

1. Given initial situation. What is known? What is the current situation?
2. Goal(s). What is the desired final situation? How can one tell if the goal is achieved?
3. Guidelines, restrictions, allowable operations. What are the rules of the "game?" What types of activities are allowed as one works to move from the given initial situation to the desired goal state?

If the situation one is dealing with has some of the characteristics 1-3 above, but not all of them, we call it a problem situation. Most real-world "problems" are actually problem situations. It generally takes considerable human thought to transform a problem situation into a formal problem. Note also that this definition does not distinguish between problems that are relatively easy to solve (math teachers often call these exercises) and more complex tasks that may require considerable research and ingenuity. George Polya's work in mathematical problem solving has had considerable influence on mathematics education during the past several decades (Polya, 1957).

For example, consider the "problem" of equity in computer education. We can come to understand the given (initial) situation. Kids in rich school districts and/or who have rich parents likely have more than average computer access. Boys may get more hands-on computer experience than girls.

But what do we want for the final goal state? And what are the means at our disposal to help achieve this state? For example, both my wife and I are Ph.D.-level university faculty members. I know quite a bit about computers and mathematics, while my wife knows quite a bit about psychology and psychotherapy. Our children have grow up in a home environment which is quite different than that experienced by most kids. It is a very intellectually rich environment, with books, computers, and emphasis upon academic excellence. To achieve equity should we expect schools to duplicate this environment for all kids? (Would we want them to, even if they could?)

Progress in formally defining the equity problem allows people to share ideas on how they attack and perhaps solve the problem. There is now a substantial literature on computer equity.

Or, consider the "problem" of software piracy. We understand the given initial situation, with large numbers of people making illegal copies of software. We might agree on a desired final state, with no illegal copies being made. But what are the means at our disposal to move from the given initial situation to the desired goal situation? How much effort is our society willing to put into decreasing software piracy?

Formal problems are nice in that one can study them in detail and one can do research to see if others have encountered and solved the same problem. Note the value of people learning the vocabulary of various problem areas so they can communicate, make use of reference books and periodicals, and build upon the work of others. And keep in mind that merely because a problem is formal does not mean that people know how to solve it or even that it is solvable.

Obviously some problem areas are more "formal" or well-defined or "science-like" than others; that is, they lend themselves to the type of study and communication described in the previous paragraph. Indeed, my brief definition of science is, "Science is description and prediction." In a science it is possible to communicate one's ideas and work over time and distance. It is possible to build upon the work of others--to have cummulative progress over time, with contributions by widely separated individuals. Computers are an aid in developing the science of problem solving, or in making more disciplines or academic areas to be more science-like.

WHOLE GROUP EXERCISE: Consider a 10-point scale, with a 1 being disciplines with the fewest formal problems and a 10 being disciplines with the most formal problems. Label your end points using disciplines that you understand reasonably well. Now, where does the discipline of education fall on your scale? Collect data from all workshop participants. Next, where do you think education will fall on you scale twenty years from now? Collect data from all workshop participants. The discussion might move in the direction of how computer-assisted learning can be viewed as an attempt to make education into a more formal problem.

I have used the above exercise in a number of workshops. Disciplines used to label the 1 point include writing, poetry, music, art, and history. (Note that there tends to be little agreement here, but one can detect patterns in the responses.) The 10 point is usually mathematics. Education is then given a rating in the 3-5 range, with a few people rating it lower and a few higher. If time permits in a workshop, it is interesting to have a discussion among those who rate education well outside the 3-5 range.

In the previous exercise, almost all people use math as the 10 on their scale and feel that math provides the purest examples of formal problem solving. Let's look at a simple math problem to help increase our understanding of formal problem solving.

> I go into a store and see an item that I have come to buy. I note that it costs $13.25. I give the clerk a $20 bill. How much change will I receive?

Even here it is not clear that this situation actually satisfies the three-part definition to be a formal problem. There may be missing information--such as the fact that there is a six percent sales tax. Is the $20 a Canadian bill, while the price is in US dollars? Am I allowed to ask another student the answer? Or, can I use a calculator?

For the moment let's suppose that this is indeed a problem, that there is no trickiness and that the problem is to be solved using mental operations along with pencil and paper. With minimal mental effort I translate the problem into a paper and pencil computation and carry out the computation.

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  20.00
- 13.25
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   6.75
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I then translate the 6.75 back into $6.75 and I am done.

Most real-world problem solving follows the steps I just illustrated. The steps are:

1. Understand what is given and make sure that the situation is indeed a problem.
2. Translate the real-world problem into a formal, solvable problem.
3. Solve the formal, solvable problem.
4. Translate the results back into a solution to the real-world problem.

In talking about "formal, solvable" problems people often use the expression EFFECTIVE PROCEDURE. Consider the following definition of effective procedure.

> An effective procedure is a detailed step-by-step set of directions that has been designed to solve a certain category of problem and that can be mechanically interpreted and carried out by a specified agent.

It is not inherent to the definition of effective procedure that it actually succeed in solving the problem. Students write computer programs that are designed to solve certain problems. But the programs may contain syntax and logic errors. For the remainder of this session we define a formal, solvable problem to be one for which we have an effective procedure which has been proven to solve the problem. Let's call this a formal, solvable problem.

Each discipline has its own types of "agents" for carrying out the steps in effective procedures for formal, solvable problems. Our overriding concern here is the computer as an agent. The computer is an interdisciplinary aid to problem solving--that is, it is a useful agent in many disciplines.

A computer science researcher tends to be concerned with whether a problem can be solved by a "theoretical computer" (such as a

Turing machine) and is not concerned with whether it might take millions of years. Reality dictates that people be concerned with getting problems solved in a reasonable amount of time using machines currently available to them. To simplify the discussion in the remainder of this session let's agree to use the following definition.

> A problem is said to be pure computer problem if it satisfies all of the following conditions:
> 1. It is a formal problem.
> 2. An effective procedure is known for solving the problem.
> 3. The effective procedure can be carried out by a computer (or by computerized equipment, such as a robot).
> 4. The effective procedure can be carried out in "reasonable" time and at "reasonable" expense using hardware and software currently available.

The class of pure computer problems continues to grow through the development of better hardware and software, through research into various problems in every discipline, and through research in computer science.

Now we are at the core of where we are headed. Computer-assisted problem solving is important because problem solving is important and because computers can help solve a wide variety of problems. Think about the following general steps in solving a problem. This set of steps is applicable only to certain types of problems, those in which a computer can be an effective aid.

1. Understand the problem. This means understand the givens, guidelines, goals. It requires both a general education and specific knowledge about the problem area.
2. Recognize or come to realize through working on the problem that it can be mapped into a pure computer problem for which a (computerized) effective procedure exists and is available to you.
3. Translate the original problem into a pure computer problem meeting the criteria/model of the effective procedure available to you.
4. Have the computer carry out the effective procedure.
5. Translate the results back into the vocabulary and situation of the given problem.
6. As best as possible, check to see if the original problem is now solved.

EXERCISE FOR INDIVIDUALS: Each person is to select a solvable type of problem within their own discipline--a problem in which a computer can aid in the solution process. Make sure that it satisfies the three-part definition of having well-defined givens, guidelines, goals. Now mentally work your way through the six step process, thinking about each step. What type of education is needed to prepare one to be able to carry out the steps?

DEBRIEF IN TRIADS: Share what you have learned with members of your triad. It is most instructive if different disciplines are represented in this small group discussion.

This exercise should also be debriefed in a whole group setting. My expereince is that many workshop participants are not able to think of good exemples. Their training and experience have not emphasized this problem solving way of viewing the world. It takes considerable training and experience to develop this way of viewing various disciplines. As a consequence of being in the workshop, it is expected that some people will make progress in incorporating the idea of pure computer problem as part of the way they view each discipline.

For me, the above analysis and discussion suggests that within each discipline we should study:

1. The general types of problem situations with which the subject is concerned. This requires acquiring a "talking" level of knowledge about the subject. The vocabulary may be more or less formal. However, we are looking for overview knowledge, knowledge that a person is apt to internalize and not quickly forget. This is part of what we call Category 2 knowledge.
2. The types of steps one can take to solve problems within the discipline. In music, for example, steps are to play certain types of chords on different types of instruments or to transpose to a different key. In art, one makes use of certain media. In math, one can draw a graph, carry out computations and solve equations. In social studies, one can arrange data into a database and then represent it in a graph, in order to support the argument one in writing in an essay. In chemistry one can carry out laboratory experiments. Each discipline has its own unique types of allowable operations as well as drawing upon more universal types of operations.
3. What constitutes a formal problem within the discipline? Examples of formal problems that can be solved. Examples of formal problems that have not been solved or that are not solvable. Insight into what makes a formal problem easy or difficult.
4. A definition of "solvable formal problem" specific to the discipline, as well as the notion of a computerizable effective procedure. That is, study solvable formal problems within the discipline both of non-computerizable and computerizable types.
5. Study of some by-hand, book-assisted, computer-assisted and other methods that exist for executing the steps of effective procedures within the discipline. The goal is a thorough understanding of effective procedure and some understanding of various agents involved in effective procedures.
6. Lots of practice in translating problem situations (especially real-world problem situations) into formal problems, along with translation of solved formal problems back into solved problem situations .

7. General study of problem solving from an interdisciplinary point of view. In this, one learns to use the basic tools of a number of different discipline. But there are also more universal tools. The three "R's" are universal tools. The computer is a universal tool.

8. Study of what to do when a problem is not within one's repetoire of solvable problems. (I don't have access to an effective procedure that can solve it. I don't know if a procedure exists. I am unable to carry out the steps of the effective procedure I have access to.) This is particularly important in the social sciences and humanities since most so-called problems in those areas do not satisfy our definition of formal problem. Computers are of more limited use in such areas.

Out of this type of analysis we begin to see how computer-as-tool affects the teaching of various disciplines. The basic nature of each discipline remains unchanged. In some disciplines there are relatively few formal solvable problems, fewer pure computer problems, and this whole approach is of relatively little value. In other disciplines this approach may cover a significant part of what needs to be covered. The basic curriculum of these disciplines may eventually undergo substantial change due to computers.

Another way to discuss the above ideas is to talk about metaknowledge. While I have a Ph.D. in mathematics, over the years I have forgotten many of the details of how to solve various categories of problems. I have knowledge of what categories of problems are solvable and I have knowledge of general categories of methods used to solve these problems. I call this metaknowledge. Might part of our formal school time be spent specifically in developing metaknowledge in a wide variety of disciplines?

EXERCISE: Working individually, make a list of five major disciplines that you feel you know quite a bit about. Each discipline should be limited to your own academic level of interest or expertise. Thus, a discipline might be math in grades 6-8 or it might be graphic arts in grades 10-12. Then order them on the basis of what part of the discipline consists of formal solvable problems. Estimate what part of these problems can be solved by computer. After your list is complete, share it within your triad. If time permits, debrief in the whole workshop group.

DEBRIEF: The concepts of formal solvable problem and pure computer problem seem to be hard for teachers to grasp. Not all pure problems are solvable, and not all solvable problems can be solved by computer. It is desirable that each workshop participant get firmly in mind one example of a formal solvable problem that can be solved by computer. This is most meaningful if the example is within a discipline the person knows well.

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SOLVING PROBLEMS WITH ROBOTS

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Industrial robots, military robots, domestic robots, fifth generation robots and even performing robots such as Star Wars' C3PO and R2-D2 are among the growing types of robots invading our today and tomorrow. These robots are being developed specificially to release a human from tedious, boring, dangerous and life-threatening jobs. Yet, robots have tended to give the impression of replacing humans and, in some cases, thinking for humans. These impressions are exaggerated in the minds of children. Reichardt (1978) notes children's comments about robots: "Robots can think and smell and hear and talk. They've got metal minds." "If I had a robot I wouldn't even have to think because he would do everything for me."

A special type of robot may aid in changing this impression. These robots are often referred to as toys, but I call them educational robots. Educational robots may be used to change the perception of "what can robots do for me or to me" to "what can I do with robots." Papert (1980) claims they can be used as "objects to think with." More importantly, they can aid in teaching problem solving and encouraging alternate thinking strategies.

Schooling and Thinking Strategies

Edward DeBono (1970) calls the thinking strategy most often taught in schools vertical thinking. Textbooks utilize vertical thinking; begin with chapter one, go to chapter two, and continue through the book until reaching the final chapter. Exercises at the end of each chapter are directly related to the material in the chapter. The student applies the content directly to the exercises; in fact, the student can be assured that the content is the means to completing the exercise. With vertical thinking the student proceeds steadily from one idea to the next by a valid series of steps. Each step is certified by the previous step's correctness. As a conclusion is reached, the student is assured of its correctness because of the logical, sequential progression to that conclusion. This thinking strategy emphasizes rules and details. It is like the analysis robots have been programmed to use. This thinking strategy might also be considered as algorithmic thinking.

According to DeBono an alternate thinking strategy that must be included in learning is lateral thinking. This strategy is distinct from and complementary to vertical thinking. With lateral thinking the steps do not have be be sequential. The conclusion is the beginning and verifying that conclusion is the process. Laterial thinking requires leaps in thought, encourages creative thinking, builds on intuition, and encourages exploration of the least likely paths. Lateral thinking emphasizes learning from errors and discovering rules or details; in vertical thinking errors indicate an incorrect path and rules and details form the correct path.

With the explosion of knowledge schooling must help students learn how to learn. Schooling must prepare students to think about problems and to solve those problems. An education requires a balance of vertical thinking strategies with alternate thinking strategies such as lateral thinking strategies. Solving problems with robots can aid in encouraging these alternate thinking strategies.

Thinking With Robots

Creating an environment for thinking with robots is not only challenging but can be exciting. The goal is to encourage different thinking strategies, both lateral and vertical. What robots can you use? What makes a robot an educational robot? And, how do you set up the classroom environment to encourage use of the different strategies? What are some guidelines for creating the activities?

Characteristics of Educational Robots

One characteristic is essential for a robot to be an educational robot. It must be programmable. Many robotic toys have this characteristic, Big Trax, the Datsun car, Brain Buggy. Each of these vehicles has a computer "on-board" with push-buttons or touch-sensitive buttons on a pad. These buttons are used to command the robot. Other programmable robots are controlled by a computer that is not "on-board"; these robots are either tethered to a computer or radio-controlled from a computer. Androbot's Topo and Fred are in this category along with the Tasman turtle, Valient Turtle, and Turtle Tot. All of these robots have a memory, whether "on-board" or in a peripheral computer; commands can be stored sequentially as a program; and, on command, the robot can be given that program for execution.

An important consideration in purchasing robots for these activities is the capabilities of the robots. What can the robot do? Find robots with different capabilities and robots with some of the same capabilities. In other words, find robots that are different. Many of the educational robots have four similar capabilities; they can go forward or back and they can turn right or left. Some robots operate on degrees, some operate on time. Some veer to the right or left rather than rotating to the right or left. Some robots require the operator to issue direction and a value for that direction at the same time; some require the direction and then the value. Some have speech capabilities; some have other sound capabilities such as sirens and horns; others have no sound capability. Some have special lights. Some have a sensing capability; they have bumpers that, when activated, indicate the current command cannot be completed as intended.

Guidelines for Creating Activities

With each robot there is a five step outline for the types of activities through which the student should be encouraged to progress.

1. Explore the capabilities of the robot.
2. Create a microworld in which the robot will operate and explore that world.
3. Create a problem within that microworld for the robot to solve.
4. Create a solution to the problem using the capabilities of the robot.
5. Test, debug and refine the solution to the problem.

Explore the capabilities. This step can be fun and frustrating at the same time. This stage is meant to be an exploration phase not a telling of the capabilities. Can you discover the capabilities of the robot without reading the manual? What do the buttons mean on the pad of the robot? Can you find words the robot knows? This stage is truly the laterial thinking stage, making guesses, trial and error, learning from the errors, discovering the rules by which the robot operates. In some of the robots ↑4 means go forward 4 lenghts; in some the same command means go forward for 4 seconds. Many of the robots have a REPEAT function. But, the most interesting aspect is that the function does not act the same on all robots. Discovering how the REPEAT function operates and how to use that function is an exciting problem. Encourage students to make guesses, check those guesses, refine their guesses. Applaud their different ideas. Explore wild guesses. The activity to conclude this phase is a summary activity, a more vertical thinking stage. Describe the capabilities and demonstrate them.

Create a microworld. For this step, the classroom (or whatever!) is redefined. Use masking tape, desks, pillows, books, etc. to create a world within which the robot will operate. This stage is creative and allows for exploration. Let the students create the scene. Then have them put the robot into the scene. They must find out how long paths are in terms of their robot's capabilities. Is a forward 40 movement a realistic movement within this microworld? Or, is a more realistic movement a forward 4? During this stage the students become familiar with the microworld.

Create a problem. Part of problem solving is finding the problem. Students must be encouraged to create a problem within this world. Create stories that enhance the problem. Which problem sounds more interesting to solve?

Move the robot from point X to point Y.

The robot has landed on a strange planet. It was out exploring the planet (carefully leaving a trail) when it noticed that it's life-support system's warning light was lit and that it's right turn capabilities were no longer operational. The robot must return to the spaceship. Thank heavens for the trail. Help the robot return safely to its spaceship.

Create a solution to the problem. This stage is the design stage. At this point the students must analyze the problem carefully, looking at any restrictions and requirements. They are required to use the skill of estimating distances and angles. If the students have not explored the microworld in detail, these estimates can be difficult (and approach wild guesses).

Working in small groups is essential in this stage. Each group determines it's own solution to the problem (none are ever the same). Each group must create a complete solution before entering the solution into the robot's memory. They can run one or two step trials to test their guesses. But each group must share the robot for this portion. The students quickly recognize a need to record their information in some orderly format. When the students believe they have a solution have them explain their plans by walking through the solution.

Test, debug and refine. This stage requires more vertical thinking than lateral thinking. The rules have been determined. The individual commands of the solution must work within those rules. Estimates for distances and angles must be refined. And, when the robot demonstrates a correct solution, the students are excited.

When all the groups have completed this step, they should compare solutions. Were all the solutions the same? Does the fact that the solutions were different necessarily mean that one was correct and the others were wrong? Where some solutions more efficent than others? What determines an efficient solution, fewer commands, less time, or some other criteria? Can other robots be used to solve this type of problem? Are some robots more suited to this type of problem than others? And, of course the ultimate question is: Can you solve the problem another way or find another problem within the microworld?

In Conclusion

An activity that can be used after all the different available robots have been explored is THE PARADE. For this activity a parade route is taped on the floor with masking tape. The route contains right angle turns and circular turns. Also, the route contains a section called the REVIEWING STAND. The problem is to have each group prepare the program for a specific robot to be in the parade. The robot is to demonstrate each of its capabilities when in front of the REVIEWING STAND.

Creating an environment for thinking with robots can bring more to the classroom than working with different thinking strategies. Certainly both lateral and vertical thinking strategies are required through these activities. Group communication strategies and cooperation are required. Estimation skills are required. And, there is more. These activities put the students in control of the robot, teach the students about the capabilities of robots, aid in developing programming skills, and encourage different solutions. These activities provide an informal lesson in programming that will carry the student into more activities with computers.

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A COMPUTER BASED HIGHER ORDER THINKING APPROACH

By
Dr. Stanley Pogrow

The basic purpose of the HOTS program is to test whether it is possible to use intensive, systematic uses of computers to improve the higher order thinking skills of Chapter I students. This is one of the first programs to use computers to change the nature of a program, and to conduct research on the special teaching and curriculum development techniques needed to take maximum advantage of the modality of the computer.

Basic findings from the program after two years are that it is possible to improve basic skills through a higher order thinking approach. Student gains in reading were approximately 14 percentile points in grades 3-6, where students are usually slipping. The students in the experimental program had 50% more friends than students in the control school, and were better on virtually all measures of higher order thinking.

Producing such gains, however, require highly sophisticated teaching and curriculum development techniques--most of which have not been discussed in the literature. Given the sophisticated nature of the teaching required, putting a computer in every class is not likely to result in substantial overall improvement. HOTS is done as a pullout with a master teacher in charge. Nor is LOGO or random thinking activities on the computer likely to produce gains in higher order thinking. They tend to produce sets of separate networks in the mind, as opposed to developing more sophisticated sets of associations among concepts already available--which together with developing more sophisticated strategies--seem to be the most important factors in improving thinking skills.

The project is developing a two year day-by-day curriculum of lesson plans for the lab teachers to use with existing commercially available software. The first year of curriculum should be available by the end of September. The project also has developed an evaluation manual with suggestions as to how to go about evaluating higher order thinking. Training is avilable in a variety of forms, ranging from a one day workshop for all teachers using computers to a week long workshop to train lab teachers.

Individuals interested in obtaining a list of the hardware and software, and/or are interested in considering establishing a HOTS program should contact me at: Dr. Stanley Pogrow, University of Arizona, College of Education, Tucson, Arizona, 85721, (602) 621-1305. Some additional information about the HOTS program follows.

HOW ARE HIGHER ORDER THINKING SKILLS DEVELOPED?

Much of the learning that goes on in schools is the rote learning of facts. While such learning is indeed important, and the automation of recall of these facts critical to higher order thinking, they are largely viewed by the student as independent pieces of information. This is depicted below:

A B C

D E F

Each of the above facts are stored discretely. What the HOTS program does is teach the child to develop rules for developing more sophisticated sets of associations between concepts that do not have obvious relationships. This is depicted below:

H

A B C

D E F

G

It is the development of the ability to construct these types of relationships that is the basis of: a) converting information in short term to long term memory, and b) the ability to generalize from the concrete to the more abstract uses of information. The ability to formulate more sophisticated networks of associations among ideas in one's mind is viewed as the basis of higher order thinking.

As such, the goal of the HOTS program is to teach students the process of generalizing new sets of relationships among pieces of information with which they are, or should be, familiar. By constructing linkages between concepts for the classroom wherever possible the time on task for basic skills is also increased thereby resulting in **improved basic skills.**

HIGHER ORDER THINKING SKILLS

- Spacial reasoning*
- Expressing logically correct persuasive positions in written form*
- Manipulating information and symbols in creative ways to produce music, poetry, new circuits, etc. Converting meaning from one symbol system to another
- Synthesizing and categorizing large amounts of information into a coherent position, decision or new idea*
- Inferring meaning from context clues
- Developing and testing systematic strategies to solve problems*
- Formal math and logic reasoning
- Planning the sequence of steps and operations needed to solve problems -- linear reasoning to structure problems into a computer recognizable form*
- Interpreting the meaning of information
- Relating ideas to each other in non-obvious ways

* Emphasized during the first year of the program

DESCRIPTION OF LINKAGE TECHNIQUES

Two main types of linkage techniques are used:

First--The curriculum of the computer lab develops associations between the concepts used in the lab and general concepts from the classroom.

Second--Every two weeks, the classroom teacher assigns a large chunk of the material covered in class which students have to reformulate. **Reformulation** involves synthesizing the information into key questions and answers, writing summaries or combining the information into new stories--which are checked by the classroom teacher. The students then **teach** the reformulated information to the computer, which uses the knowledge to organize a variety of contests and challenges.

The second type of linkage activity gives teachers control in determining which material covered in class will be reinforced through the computer lab. It also forces the student to deal with synthesizing, and developing linkages between, large blocks of information.

It is important to emphasize that content and specific subjects are not taught in the computer lab. The function of the lab is to provide an environment in which students are taught, and have an opportunity to use, the general intellectual processes involved in working with information from across a variety of subject areas. *The teaching of information remains the primary responsibility of the classroom teacher*. Over time the classroom teachers are also provided with inservice training on how they can ask more challenging questions of the students.

IMPLEMENTATION REQUIREMENTS

In order to implement HOTS effectively, a school must do the following:

Have a master teacher in the computer lab. It is more important that this teacher be familiar with the latest techniques of teaching reading and writing, and using questioning techniques than being a computer whiz.

Provide each student with at least a half hour a day in the computer lab 4-5 days per week. Standards for equipping the lab are attached.

Have a good school effectiveness program going with the classroom teachers. This program should emphasize time on task and direct instruction techniques. The curriculum should also previously have been aligned with the standardized tests.

The principal must build a bridge between the lab and classroom teachers such that the clasroom teachers will understand and cooperate in the linkage activities.

It should be emphasized that this program takes the place of a regular compensatory program. Schools in the project use state compensatory and Chapter I funds to purchase the needed equipment. HOTS teachers are able to work with more students than a regular compensatory program.

Over time a HOTS program costs no more, and probably less, than the typical compensatory program.

IMPLEMENTATION COSTS

Costs to equip a lab:

Approximately $17,000 for a lab to service 60-70 Chapter I students. A lab to service 120 students will cost approximately $34,000. Hardware and software standards for the lab are attached.

Personnel:

One master teacher with about 8 computers can handle up to 60-70 students. Additional students, up to approximately 120, will require an aide. The lab teacher should be someone with creativity and energy who is committed to improving learning.

DESCRIPTION OF THE HOTS CURRICULUM

The function of the HOTS Curriculum Guide is to systematically operationalize the process of developing the associative networks that are the basis of higher order thinking. The detailed curriculum guide decribes how to use the software and hardware on a day by day basis. The guide for the first year of activities should be available late summer.

The basic goal of the curriculum is to organize computer use activities so that an environment for developing generalizations and association is created.

Unlike random computer use activities, or programs where it is often assumed that generalizations will occur spontaneously, the computer activites are integrated with teaching strategies that are designed to develop specific types of associations.

The basic strategies used in the design of the curriculum are to:

- Take a basic concept or idea and have the student use it in a variety of very different contexts and begin to realize the general characteristics of the concept beyond the specific context in which it is orignally learned. For example, the same numerical estimation strategy that is optimal for guessing the missing number on a number line is the same as to guess the best price to charge for apples and to find the Hidden Bumble on a grid.

- Design a task that requires the use of information from a wide variety of contexts and subjects to solve. For example, the talking robot, TOPO, provides an opportunity to integrate many concepts from math, vocabulary, phonics and writing into the development of a robot play.

- Link the ideas and strategies discovered by the student to some concept from the regular classroom wherever possible.

Approximately half of each session is spent on thinking away from the computer during which time the teacher poses challenge questions and/or provides an opportunity for the class to discuss their findings. These pre and post-teaching activities are essential if students are going to internalize the asociations they have been forming. The pre and post-teaching activiites are also described in the Curriculum Guide.

COMPUTER-AIDED VISUAL LANGUAGE WITH THE MACINTOSH

Richard Wanderman

As microcomputers become easier to use, cheaper and more widespread, their appropriateness as compensatory learning and productivity tools for people with language disabilities such as dyslexia will become taken for granted. We haven't reached that point yet, although we are certainly close. Using computers is still relatively complex, and using most of them involves precise use of the English language. But there is movement in the computer industry toward more visual as well as other, non-verbal computer interfaces making the use of computers less dependent on written language. The Macintosh computer is an example of such an effort.

Much attention in the remediation of specific language disabilities is focused on the use of multi-sensory learning. Multi-sensory learning is the use of more than one sense in taking in information. Many remedial reading classes use sight, sound and touch together to cross-reference and reinforce each other.

Taking off from what we already know about effective remediation, I would like to discuss why the Macintosh computer is an appropriate prosthetic device for people with language disabilities like dyslexia.

The Macintosh Working Environment

The Macintosh computer is different from most other microcomputers in that it uses a visual as opposed to a command-line interface. The Apple II, IBM PC and virtually all other microcomputers use a command-line interface. With a command-line interface one types a command or series of commands to make the computer do things. This raises problems for many people using these types of computers; the same problems are exaggerated in the case of the dyslexic person. A few of the problems:

- One has to know the commands in order to type them. This involves memorization.
- One has to spell the commands correctly for the computer to execute them. This also involves memorization. Many of the commands are contractions which aren't always phonetic in nature and therefore hard to memorize.
- The syntax of the command structure in many operating systems isn't intuitive or body-centric.

Another aspect of virtually all microcomputers except the Macintosh is that there is no standardization in the way programs work within the various operating environments. This means that to use three or four programs within any of the non-Macintosh operating environments, one has to memorize different commands for each program. For the dyslexic person with poor memory skills, this type of memorization is hard if not impossible.

Standardization

Apple has made some important underlying decisions about the way they want people to interact with the Macintosh. One of the most important is that the Macintosh operating environment should be (and is) standardized: all programs, whether written by Apple or third party software houses, look and operate in similar ways. Much of the Macintosh interface is built into the computer's ROM and as such is a semi-permanent part of the machine. All software runs within and interacts with this standard visual environment. Unlike other microcomputer software, almost all Macintosh software shares a common operating syntax and a common visual style. The Macintosh operating system (Finder), being another program that interacts with and uses the ROM interface, also looks and feels like every other program that runs on the machine.

Needless to say, this standardization makes using the Macintosh easier than virtually any other computer on the market. In the case of the dyslexic person, this ease of use is critical to their using a computer at all. It is unreasonable to expect people with language disabilities to memorize the numerous commands, their spelling and syntax used to run the various programs that run on computers other than the Macintosh.

The Visual Interface

The Macintosh visual interface is a different way of making a computer do things. The interface consists of: iconic representations of programs, their files, and utility functions; standardized pull-down menus for operating on files; windows to visually hold the contents of disks and folders; the mouse, a pointing tool for moving around the screen and making selections. The visual interface is made possible by a high resolution, black and white, bit-mapped screen.

Icons

Icons visually represent files or functions on the Macintosh screen. To make a selection within the Macintosh environment, one points to an icon with the mouse and clicks the mouse button. The icon for the MacWrite program is a small graphic symbol of a hand writing on a piece of paper with the word "MacWrite" written under it. The icon for the MacPaint program is a hand brushing on a piece of paper with the word "MacPaint" written under it. One never has to write out the word MacWrite or even recognize the word to select the program; one simply points to its icon and clicks the mouse button. Correct spelling isn't an issue within this environment; the keyboard isn't used in making selections.

All programs that run on the Macintosh have their own, distinctive icons. The files created by different programs also have their own icons and these in some way relate to the creator program's icon. Most icons in some way visually represent the function of the program they belong to.

Pull-down Menus

Instead of having layers of menus that can get in the way when working, all Macintosh software uses pull-down menus located in a line on the top of the screen and available at all times. Menus are activated by pointing with the mouse to the menu of choice, then holding the mouse button down to "pull" the menu down revealing specific menu choices. The visual feedback and kinesthesia involved in making a menu selection with the mouse makes learning how to manipulate menus fast; it usually takes about three minutes for people to learn how to use Macintosh menus. Once learned, menu use never has to be re-learned as all programs use the same menu system. Most menu selections are one or at most two words long. This makes reading them easier for the dyslexic person.

Windows

A window is a visual/spatial partition showing the contents of something on the screen. For example, to see what the contents of a particular disk icon are, one opens the disk's window revealing icons representing the disks contents. One can have many windows showing at one time so that one can compare the contents of different disks. Manipulating windows is visual and kinesthetic. One drags them around the screen to move them; one re-sizes them by dragging one of their corners. Windows appear throughout the Macintosh environment and their functions are standardized. The visual/spatial aspect of windows works well for the dyslexic person who might not be able to remember the contents of command-line directories to compare them to one another.

The Mouse

The mouse is a pointing tool that replaces the cursor keys on other computers. The mouse not only makes moving around the screen easier and faster than cursor keys or joysticks; it is what makes the use of icons windows, and pull-down menus possible. The kinesthetic feedback that comes from moving the mouse, coupled with the visual feedback of icons, windows and pull-down menus, makes a for powerful, multi-sensory learning system. This system makes learning to use the machine faster and easier. For the dyslexic person, this system makes complex, autonomous interaction with the computer a possibility.

The Screen

The Macintosh's high resolution black and white screen not only makes it's iconic/visual interface possible, it makes reading text easier. For the dyslexic person who has a hard time with reading under ideal conditions, a low resolution computer screen makes reading hard and sometimes painful. There is enough negative feedback in the reading process for the dyslexic person without adding more with a poor screen. The Macintosh screen being easy to read, causes less eye strain than most other screens and because of this will contribute little or no negative feedback to the reading process.

Computer-aided Writing

Computer-aided writing is the most important part of a dyslexic person's use of a computer. The Macintosh visual interface extends to it's writing program: MacWrite, making it the easiest to use computer-aided writing tool on the market.

What Makes Computer-aided Writing Different?

Electronic writing and editing radically changes the writing process. Using a computer and writing program makes possible the separation of writing (composition), from printing. This separation makes writing and the learning of writing easier for people with writing problems.

- No more drafts. Once written, the original draft is edited and re-edited, adding and subtracting words and sentences but never re-writing the whole thing. This is especially appropriate for the dyslexic/dysgraphic writer who has a hard time producing clean copy.
- Text can be re-arranged by electronic cutting and pasting. This helps compensate for the global organization problems many dyslexics have.
- Spelling can be easily corrected either with the mouse or with an electronic spelling checker.
- Because reading text on a screen is easier than reading a handwritten draft, proof reading is now a more realistic possibility for the dyslexic/dysgraphic reader/writer.

MacWrite

MacWrite is the Macintosh writing program. It isn't the only writing program that runs on the Macintosh but it's by far the best designed and easiest to use. MacWrite is an extension of the Macintosh working environment. It embodies all aspects of the visual interface that make using the Macintosh easy and appropriate for people with dyslexia. Apple includes this program at no extra charge with the purchase of a Macintosh.

Long-term Effects of Computer-aided Writing

In our culture, reading and writing are important parts of the learning process. People who don't actively participate in these activities are not only disabled learners, they are missing an important channel of information exchange. In the case of the dyslexic person, the use of a computer as a prosthetic writing tool helps compensate for many of their specific language problems and makes written, verbal expression possible.

Computer-aided Drawing

The dyslexic/dysgraphic person not only has trouble with the formation of letter forms, but many times with drawing in general. Traditional drawing, like writing, is done with paper and pencil or pen. The composition process is wed to the printed product and a mistake usually means either erasing or starting the whole drawing over again. Also, like writing, drawing skill comes from experience: if a person doesn't draw (because they're scared of making mistakes), they don't learn and develop skills from their own experience.

Computer-aided drawing on microcomputers existed only in crude form prior to the Macintosh. The Macintosh's bit-mapped, high resolution screen, visual interface, and mouse, along with the MacPaint drawing program make computer-aided drawing fluid and easy.

MacPaint

MacPaint puts the same type of electronic editing power found in good writing programs in a drawing tool. As with computer-aided writing, drawing with MacPaint separates composition from printing making a new type of graphic editing process possible. People who are intimidated by drawing with pencil and paper find drawing approachable and enjoyable with MacPaint. For the dysgraphic person, MacPaint eliminates many of the problems found in traditional visual expression. MacPaint is also a significant learning environment in that there is an easily figured out (by trial and error) syntax for using it's tools. As with MacWrite, printing a MacPaint image is easily done and there is absolute fidelity between what one sees on the screen and what the printer prints. Also like MacWrite, MacPaint is included at no extra cost with the purchase of a Macintosh.

The Value of Drawing

Drawing is an important skill that many of us have never developed. It not only gives perspective to our writing but it can, and is used as an analytical tool to see ideas in different ways than are possible with the printed word alone. Writing lacks a visual/spatial aspect and as such cannot always express our ideas. Many times we push our writing too far because we feel that drawing isn't a viable alternative. For the dyslexic/dysgraphic person who is having a hard time with writing, drawing can become a significant part of their personal expression. Unfortunately, many of us have rigid models of what good drawing is and what it should be used for. We're too quick to link drawing to fine art. When we let go of the fine art association, drawing can become as important a part of our process of information exchange as reading and writing are.

Many times a person's seeming inability to draw is caused by a disinterest in the subject matter of the drawing. All of us have a hard time writing about a subject that bores us and so it is with drawing. Also, many people hold to the talent myth and don't believe that drawing, like writing, is a skill that must be developed and nurtured. When drawing isn't held up as high art and is made personally relevant, a dyslexic/dysgraphic person usually finds it enjoyable and useful. And as with writing, the more drawing a person does the more skilled they become with the medium. What the Macintosh and the MacPaint program do is make the drawing process fun and give it new life. Instead of focusing on our inability to draw we can instead focus on the new tools and what they do. This invariably leads to more work and more enjoyment of the drawing process.

Other Macintosh Programs of Value to the Dyslexic

Think Tank

Think Tank is an outlining tool that makes the organization and presentation of ideas easier. It uses all of the standard Macintosh conventions for working with text and includes some excellent new ones of its own. To move a group of words in a body of text into a new location, one actually grabs and pulls them into their new location with the mouse. This eliminates the use of menus and is extremely fast and easy. Another important aspect of this program is that it allows the collapse of sub-headings into their headings. With this one can see one's outline in full detail or just partial detail. For the dyslexic person with global organization problems this feature is important. The process of collapsing is done with the mouse by clicking on the heading one wants the sub-sub-headings of hidden or revealed. Think Tank allows ideas to be treated as modules and as such, experimented with. It is a significant program for the dyslexic person using a Macintosh.

Smoothtalker

Smoothtalker is a speech synthesis program that allows one to hear ones writing spoken in a digitized voice by the Macintosh. The program is easy to use and the voice is coherent and controllable. The significance of this program for dyslexic people is that it allows them to deal with verbal expression using more than one sense. In listening to one's writing read out loud, one can hear spelling mistakes and mistakes of syntax easily.

ChipWits

ChipWits is a simulation program where the user programs (teaches) a graphic representation of a robot to move through an environment, interacting with the environment's various features. It is the most concrete introduction to programming available on any microcomputer. Like working with the LOGO language, ChipWits teaches more than programming methodology; ChipWits is an excellent structured learning tool. The ChipWits language is iconic and using it involves easily understood, logical manipulation of the various iconic operators and their arguments. The ChipWits program has rich graphics and sound which add to it's usefulness for the dyslexic person.

There are a rich variety of other Macintosh programs for the dyslexic person. A digitizer such as MacVision turns the computer into a video recorder/picture maker. There are music programs that not only allow the Macintosh to play music, but teach musical notation. There are a variety of games and simulations that not only teach users about the Macintosh interface but are structured learning environments. There are typing programs that teach touch-typing.

And there are even "educational" programs that, through traditional drill and practice techniques, attempt to teach math, spelling and other subjects. I believe that the Macintosh is an educational tool as is, without imposing limited value drill and practice programs on students. Moving around within the Macintosh environment, using various programs to get real work done is of more lasting educational value than using drill programs to learn one isolated skill. Even very young children quickly learn to use and enjoy MacPaint. Though most schools use Apple II computers and much C.A.I. software, I feel that this software fails to take advantage of the real usefulness of computers. Computers, especially the Macintosh, are interactive, exploratory tools and should aid in making students autonomous learners and active explorers.

Concluding Observations

What matters more than the type of computer the dyslexic person chooses to use, is the spirit in which it is used. Any computer, including the Macintosh, used in an environment of pressure and lack of personal interaction and caring will just amplify the problems the dyslexic person had pre-computer.

Using a computer as a tool for personal expression helps us see our ideas outside our heads. By helping eliminate the expressive block of worry about mistakes, computers help feed more work which in turn feeds more ideas which feed more work. For the person who has little confidence in their ability to express, let alone have, original, personal ideas, the use of a computer is revolutionary. The Macintosh can make this cycle happen more quickly because it makes computer use more approachable and easier than other machines.

There is little doubt that the way the Macintosh works is the way most computers will work in the near future. Even now there are visual interfaces like the Macintosh's being developed for the IBM PC. For the dyslexic person, visual interfaces like the Macintosh's are opening the doors to personal expression. Once opened, those doors never close.

The Effectiveness of Interactive Video for Teaching Handicapped Learners: Preliminary Findings[1]

by

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Gary Nave, and Patti Zembrosky Barkin[2]

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[2] Dr. Browning, who is Professor in the Division of Special Education and Rehabilitation and Research Director of the Rehabilitation Research and Training Center in Mental Retardation, is Director of the Interactive Video Project. Mr. White, Mr. Nave, and Mrs. Barkin are Project staff.

Interactive video has the ability to combine computer assisted instruction and educational video as an effective learning medium. It has been defined as:

> . . . a system of communication in which recorded video information is presented under computer control to active users, who not only see and hear the pictures, words, and sounds, but also make choices affecting the pace and sequence of the presentation. (Hoekema, 1983, p. 4)

The benefits of this new instructional technology are many. For example, the computer assisted instruction component allows for such learning features as immediate feedback, repeated trials, and active learner participation. The video component adds to these instructional dimensions in that real-life situations can be portrayed, appropriate models presented, and reading requirements minimized, if not altogether eliminated.

Even though this instructional technology is relatively new, it is altogether surprising that it has received such little attention with the handicapped learner given its combined benefits for learning. In a comprehensive review of the literature, for example, only 37 references pertained to this learning technology out of over 500 literature sources on computers and the handicapped (Nave, Browning, & Carter, 1983; Browning, Zembrosky Barkin, Nave, & White, 1985). Furthermore, 17, or nearly half, of these citations were authored by one of three people and/or their respective cohorts.

One of the settings in which interactive video for handicapped learners is receiving attention is the Rehabilitation Research and Training Center in Mental Retardation (R-T Center) at the University of Oregon. The nature of the Center's research and demonstration efforts was described in last year's published proceedings of this conference (Browning & Nave, 1984). These efforts have been dubbed Project LIVE, which is an acronym for Learning through Interactive Video Education. The two major objectives of Project LIVE are to (1) develop interactive video courseware for the handicapped learner, and (2) research the teaching effectiveness of this technology for these individuals. The purpose of this paper is to briefly present the nature of the courseware/hardware being developed through this program and to highlight the results of a recently completed pilot study.

Courseware/Hardware

A major objective of Project LIVE is to develop a life-centered, community-referenced interactive video curriculum series aimed to enhance the successful community adjustment of handicapped learners. The series includes six life enhancement skill domains: (1) knowing your rights, (2) being responsible, (3) solving your problems, (4) asking for help, (5) relating to others, and (6) thinking positively. Unlike some of the more basically situation-specific skills (e.g., cooking) taught to these persons, these life enhancement skills are relatively generic in that they apply across settings (i.e., home, work, and community).

The skill areas to be taught in this curriculum series contain teaching points which apply across settings. Thus, multiple settings, people, and cues in various video scenarios visually depict single teaching points. In addition, the learning modules are being designed to introduce the learners to a wide array of situations in which the skill(s) is applicable. Of course, the users' continuous interaction with multiple events occurring in multiple settings is intended to introduce them to the broad range of possibilities for which the learning point is functionally suited.

The courseware is relatively novel when contrasted with typical features of most computer software. First, it is designed for the teacher/trainer to assume a significant role. In essence, the teacher has "control" over adapting the materials to the students' needs in that the teacher is able to decide, to some extent, the path that the computer program follows, how many and which response options are selected for each problem situation, and whether to repeat the problem or proceed to the next one. Also, pauses are built in for discussion, and other instructional activities are included in the lessons as teacher options (e.g., verbal rehearsal, behavioral rehearsal, homework). The second feature that is somewhat novel for software is that the curriculum is primarily designed for small groups instead of individual students. Not only can the participants learn from each other in discussion, decision making, and role playing, but small group teaching serves as an efficient use of teacher time.

The hardware used to operate the interactive video courseware is the computer, videotape player, monitor, and interface card. More specifically, the needed equipment is an Apple II series microcomputer, one of two 1/2" Panasonic industrial videotape players (NV-8200 or AG-6200), a BCD 450 computer videotape recorder interface card, and any color video monitor with separate audio and video posts.

Pilot Study

The second objective of Project LIVE is to research the effectiveness of the interactive video courseware on life enhancement skills. Presented in this section are the highlights of a recently completed pilot study on the "Asking for Help" learning module.

This learning module is an eight-lesson curriculum comprised of 3 hours and 10 minutes of videotape running time. Although the tape for the longest lesson runs 35 minutes, each lesson requires at least one class period (55 minutes) due to a number of instructional factors such as curriculum branching, decision making, review, pauses for role play, repeated trials, and discussion. The scope and sequence is organized according to the major areas of why, when, who, in what situations, and how to ask for help. A total of 49 learning points are subsumed under these areas.

Three groups of subjects were selected to participate in the study. Groups 1 and 2 were high school handicapped students who were affiliated with the special education resource room program, whereas, Group 3 consisted of adults who resided in a workshop setting which provides mentally retarded people with supervised employment. Table 1 presents the age and IQ profiles of these three groups.

Table 1

Subject Characteristics

Group	n	Age (yrs. - mos.) Mean	Age (yrs. - mos.) SD	Age (yrs. - mos.) Range	WISC-R IQ Mean	WISC-R IQ SD	WISC-R IQ Range
1	13	17-8	1-5	15 to 20	64.9	15.0	45 to 88
2	8	16-10	1-3	14 to 18	64.1	8.1	52 to 72
3	5	26-0	5-5	21 to 34	57.4	16.0	42 to 83

Student achievement, and student and teacher reaction(s) to the curriculum were measured using five instruments (i.e., Curriculum Knowledge Test, Lesson Answer Sheets, Teacher Lesson Questionnaire, Teacher Curriculum Questionnaire, and the Student Curriculum Questionnaire). For the purpose of this paper, attention will be centered primarily on the results of the first measure.

The Curriculum Knowledge Test, which is in the process of being psychometrically standardized, contains 54 true/false items which are closely aligned with the curriculum teaching points. Table 2 contains the pre- and posttest Knowledge Test results for the three groups.

Table 2

Knowledge Test Means and Standard Deviations

	N	Pretest		Posttest	
		Mean	SD	Mean	SD
Group 1	13	22.0	5.7	24.6	5.9
Group 2	7	21.0	5.6	22.3	3.5
Group 3	5	16.2	3.7	21.2	6.3
Overall	25	20.6	5.6	23.3	5.4

Group 3 subjects benefited most from the curriculum, with an average gain of 5 points. Overall, the pre- to posttest improvement for the 25 subjects was statistically significant at the .01 level (t = 3.54, df = 24). The overall improvement also translates to an effect size (Glass, McGaw, & Smith, 1981) of 0.48. If the pretest scores are representative of the typical knowledge about requesting assistance of a population for whom the curriculum is targeted, then an effect of this size means that the curriculum brought about a move for the 25 individuals from the 50th to the 68th percentile within the population. In all, 19 of 25 students gained from pre- to posttest scores. This corresponds to a p value of .007 according to the binomial test.

Three teachers filled out the Teacher Curriculum Questionnaire--the experimental teacher, as well as the regular Special Education teachers of Groups 1 and 2 (who were observing the piloting). All teachers indicated that they liked the content focus of Asking for Help and that it was enjoyable and relevant for the students. They indicated that the curriculum, on the videotape and in the teachers' manual, clearly presented the learning points and that it was easy to use. The high school students, via the Student Curriculum Questionnaire, indicated their reactions to Asking for Help. Eighty percent found the lessons easy, 65% enjoyed the lessons a lot, 80% thought the information in the lessons was new, and 70% would look forward to more lessons "like these."

In summary, the students seemed to benefit from the curriculum irrespective of their functioning levels. Most students in all three groups made gains of the Knowledge Test. Also, correlations between Knowledge Test scores and IQs for 23 students were low and statistically nonsignificant (r = .33 for pretest, .34 for posttest). Possibly, Asking for Help had "something to offer" for just about every student in the pilot test--whether that "something" was an increased awareness and appreciation or a better understanding of specific learning points.

A major purpose of this pilot study was to prepare this curriculum and its related measures for field testing on a larger scale. This was accomplished by cleaning-up the programming, editing the teacher's manual, and modifying and refining the measures for the larger-scale field test study. Table 3 presents the evaluation measures prepared for the field testing and their schedule for administration.

Table 3

Schedule for Assessment

Measure	Administration in Relation to Curriculum before	 during	 after
Curriculum Knowledge Test	X		X
Curriculum Application Test	X		X
Lesson Answer Sheets		X	
Student Curriculum Questionnaire			X
Teacher Lesson Questionnaire		X	
Teacher Curriculum Questionnaire			X

The field test using the Asking for Help curriculum has now been completed. Included in this study were 11 secondary special education sites in the State of Oregon, 14 teachers (two teachers at three of the sites), 19 groups of students (two or more groups for some sites), and 115 adolescent or young adult mentally handicapped learners. The results of this investigation are currently being analyzed and will be published in the near future. Finally, other life enhancement skill curricula are currently being developed by Project LIVE staff. These interactive video learning modules will also be field tested in these same sites, using the same Schedule for Assessment as in Table 3.

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LOCAL AREA NETWORKS: COMPONENTS, LIMITATIONS, AND EDUCATIONAL APPLICATIONS*

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Introduction

As the number of elementary and secondary schools with multiple microcomputers continues to grow, more and more school districts can be expected to begin considering the benefits of linking their microcomputers together on some type of local area network to share hard disks, high speed printers, modems, and even photocopiers. But before schools rush out and buy microcomputer LANs, there are a few things they should know about a LAN: What is it? What are its basic components? What use is it in schools? What are its current limitations?

What is a LAN?

Well, for openers, it's not two tin cans tied together with a string. And its not a local television station. It could be a bunch of sailors sending messages with signal flags if they could move fast enough. But it's not. What it is, for most schools, at least, is a system composed of both hardware and software that allows computers and other devices to be connected together using wires or cables so data can be transmitted at high speeds over limited distances--such as an office, classroom, or building.

What Are Its Basic Components?

The size and capacity of an instructional LAN may vary depending on the number and size of the instructional programs or computer languages supported as well as the number of microcomputers attached. The basic components of a typical baseband LAN for, say, twenty Apple microcomputers installed in a high school computer lab are as follows: (1) one network interface card for each microcomputer to connect it to twisted-pair wire that physically links the various components of the network together; (2) one file server that manages access to a high-speed hard disk storage unit; (3) a hard disk storage unit with forty-five megabytes of storage capacity; (4) a print server to manage access to at least two printers--generally one high-speed dot matrix printer and one letter-quality printer; (5) network software such as microcomputer operating systems support, print spooling, and network management; (6) assorted network hardware such as tap cables, network cables, and tap boxes; (7) miscellaneous network and device protection and life-extending equipment such as surge suppressors, desktop antistatic mats, and external fans for each Apple microcomputer to dissipate internal heat buildup; and (8) network installation and operation documentation. Although built-in or add-on disk backup and archival storage equipment is available for LANs, it is seldom acquired for instructional applications.

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*This paper is based for the most part on a chapter the author prepared for the 1986 Yearbook of the National Society for the Study of Education (NSSE) on "Education and Micro-electronic Technologies," edited by Jack Culbertson and Vern Cunningham. An advanced version of the chapter is available from the ERIC Clearinghouse on Educational Management, University of Oregon, 1787 Agate Street, Eugene, Oregon 97403.

A typical baseband LAN installed in a school office will have many of the same components as that of an instructional LAN. The office LAN, however, is usually smaller, includes both letter-quality (laser is rapidly replacing daisy-wheel) and dot matrix printers, has built-in or add-on disk backup and archival storage, provides for the electronic transfer of messages between microcomputers, and frequently uses coaxial cable instead of twisted-pair wire. Some of the more expensive office LANs have a file transfer server (a bridge) that allows for the exchange of files between similar networks, while other LANs not only support the exchange of messages or files between microcomputers on the network but also between those located in, say, other offices or classrooms in or outside the building or even in the home. With office microcomputers more frequently downloading files directly from central computers, several office LANs are providing gateways (protocol translation devices) to mainframe computers like IBM. Local area network gateways to value added networks like Tymnet and Telenet are also becoming available.

What Are Some of the Major Instructional and Management Applications of LANs in Schools?

The linking together of several microcomputers on a LAN provides for several advantages not available from a single microcomputer alone. With microcomputers linked together on a LAN, students can not only share the use of public domain and network-licensed instructional software, but the teacher can unobstrusively monitor students'progress as they work at their own microcomputers. In addition, with the use of network-compatible filing and database management programs, the network supports the central storage of student work and records, making the assessment of student progress and other aspects of classroom management easier and more effective. [1] Another advantage of the network is the opportunity for applications in most school districts, the use of LANs to link office microcomputers is not only still in its infancy in the majority of school districts, it's not even born. Once a sufficient number of microcomputers are added to the district or building-level offices, the addition of a LAN to link clusters of microcomputers in these offices can be justified. Once installed, a LAN's administrative applications are many. Record keeping, word processing, budgeting, scheduling, and inventory control are but a few of the administrative applications that can be enhanced with the use of an office LAN. LAN vendor-specific vertical applications software--that is, software designed for a specific group of users--is available for school attendance, student registration, school scheduling, and grade reporting.[5]

Several companies have also produced multi-LAN-compatible software specifically for school administrative applications such as budget tracking, inventory, student records, and scheduling. This software runs on a Novell LAN (NetWare/S) as well as on the hardware of several other LANs using NetWare/OS--Novell's network operating system software--including Omninet (Corvus), Multi-Link (Davong), EtherSeries (3Com), PLAN 2000 (Nestar), and PCnet (Orchid). [6]

A growing number of general purpose administrative application programs such as word processing, electronic spreadsheet, database management, accounting, and electronic mail are currently available for several LANs. [7] Other programs are being developed specifically for certain LAN vendors, especially 3Com and Corvus. A few popular business application programs such as VisiCalc (spreadsheet) and dBASEII (database management) will already run on certain LANs and are licensed to do so. And, in addition to the education-specific administrative software described in the previous paragraph, several companies are producing general administrative software compatible with LANs using Novell's network operating system.

Microsoft Networks, a multi-LAN operating system, has recently been released by Microsoft, the developer of MS-DOS (the defacto standard 16-bit operating system for IBM PC and PC-compatible microcomputers). Many industry experts believe that Microsoft Networks will also become the de facto standard operating system for LANs, thereby providing "the critical interface between application software and network hardware." If this does happen, the system will attract adoption by many LAN hardware and software vendors as well as hundreds of single-user application software companies. [8]

What Are Some of the Current Limitations On the Use of LANs in Schools?

several microcomputers to share expensive peripherals such as letter-quality printers and graphic plotters. This sharing can often result in modest cost savings as well as more efficient use of such equipment.

The final major benefit of networks is obtained through the use of communications packages, bridges, and gateways. With these devices, microcomputers on a network can send and receive files between similar systems, share information between microcomputers using similar software, send and receive messages (electronic mail), send and receive files from mainframes and minicomputers, and link with value-added networks such as Tymnet and Telenet for local access to bibliographic database services such as Dialog, BRS, and Orbit. These database services are particularly valuable to educators because in effect, they turn the microcomputer into a library. From the classroom, office, or home, the teacher or administrator can search for and retrieve information from over 100 databases such as ERIC, Books in Print, National Newspaper Index, Microcomputer Index, Psychological Abstracts, and Dissertation Abstracts.

Several companies are marketing instructional software for LANs, especially those linking Apple microcomputers. For example, Ideal Learning is marketing a series of full-year instructional packages for sixth-, seventh-, and eighth-grade mathematics, science, and foreign languages to operate on Corvus's Omninet LAN linking Apple II microcomputers. [2] According to the vice-president of the company, over 100 schools, primarily in Minnesota and Wisconsin, are using its instructional software on Omninet LANs linking Apple microcomputers. Public domain instructional software developed by the Minnesota Educational Computing Consortium (MECC) is reportedly running on Nestar's LAN in a few San Francisco high schools. A quarterly journal called The Educational Networker, published by the Corvus National Educational End-Users Group, lists several pages of public school and college-level instructional software tested for compatibility with Corvus network operating systems. [3]

One of the largest recent installations of IBM PC microcomputer LANs for instructional applications is in the Indianapolis School District. In mid-1984, the district installed Orchid's PCnet LANs in its nine high school microcomputer labs. Each lab contains 31 PCs and three printers connected in a network cluster. The system uses computer-assisted instruction (CAI) software for English and math instruction. [4] Several other large school districts are reported to be considering LAN installations by late 1985 or early 1986.

Because the use of microcomputers for administrative applications is significantly behind that of instructional

The identification and analysis of four major limitations in the use of any microcomputer LAN available on the market today, two of which are discussed in this paper, is based primarily on research involving interviews of LAN users and evaluations of LAN hardware and software [1, p. 8]. These four limitations are as follows: (1) The need for network management, (2) the shortage of technical support from retail stores and LAN vendors, (3) the lack of multi-user database management system (DBMS) software, and (4) the legal barriers to the use of single-user software on LANs. Two of these limitations--the need for network management and the legal barriers to the use of single-user software on LANs--will be highlighted.

Need for Network Management

The management of a local area network for microcomputers is not a trivial process. For the stand-alone microcomputer, software applications in education are numerous and well documented for some machines such as the Apple. The opposite is true for most local area networks. More often than not, one must be able to write special programs in the language of the LAN application software to ensure full utilization of the network. Furthermore, when resource sharing is one of the objectives of the LAN, someone has to set priorities for access to printers, graphic plotters, and other peripherals, as well as manage the output. As one leading authority on LANs said in responding to a question on what companies usually overlook when they decide to network,

> [t]hey underestimate the amount of technical tickling a network needs--everything from putting in a network card to organizing all the files on the server to writing utility programs. These are not trivial endeavors. Companies also don't realize that they will need someone in-house who knows how to administer files, do backup and recovery, add new users, change user passwords, and so on. Administrative duties never go away with a network. Planning is essential; you have to think through the problems of computer systems administration; if you don't, you'll pay a penalty before long. [9]

In the case of most local area networks the heavy workload is at the beginning. Installation--the process of setting up and debugging the network--can take anywhere from two weeks to two months or longer, depending upon the type of the network and the range of software applications. Implementation tasks include creating volumes for users, writing utility programs so that the application software that users are accustomed to running on a single computer operates in the same manner on a network, writing a network users' handbook so everyone understands how to use the full capabilities of the network, and--where expertise is not available from the local retail store or network vendor (as is often the case with LANs)--physically connecting all the parts of the network together and making it work.

A report on local area networks issued by Academic Computing and Information Systems at Stanford University identified the following areas of responsibility for the typical LAN systems manager: Installation planning, installation, acceptance testing, creation of user accounts, allocation and management of disk space, software installation, customizing the network, informal training and consulting of network users, regular system backup, printer management, troubleshooting, and arranging for repair calls and regular maintenance. [10] All but one of these tasks are inherent with local area networks; that is, these areas of responsibility should continue for some time to come regardless of likely improvement in the ease of network installation and use. The one exception is customizing the network, the task of making single-user application programs operate satisfactorily on the network; this problem will be greatly reduced, if not eliminated, with the growth of commercially available network-adapted business and instructional software.

Because the introduction of a LAN into the office or classroom "means training personnel, reorganizing procedures, and often learning new programs," [11] a network manager must have a combination of problem-solving skills, systems-programming expertise, and training and experience as a manager. Furthermore, such a person should like to learn, to teach, to be patient and systematic, and to be "comfortable working with simple tools, e.g., a screwdriver to remove the PC's cover ... to insert and remove plug-in boards." [10, p. 30]

Legal Barriers to the Use of Single-User Software on LANs

Not only is most popular database management systems software not available for the local area network, but LAN versions of popular single-user word processing programs like BankStreet Writer and Wordstar or spreadsheet software like 1-2-3 or Multiplan are not available either. Though they are likely to be for some LANs at least by the end of 1985. The reason a single copy of these programs cannot operate on LANs is largely due to legal barriers, rather than technical ones. To legally use any of these programs on a LAN, one must buy one package for each microcomputer on the network! To do otherwise is to violate either the software vendor's licensing agreement, which accompanies each box of program diskettes, or section 117 of the Federal Copyright Act of 1976, which makes

> [i]t . . . [im]permissible [for one] to take a program that was not designed to copy itself in a network, and to distribute it to the various personal computers in the network. For example, down-loading Wordstar or VisiCalc from a master disk into other personal computers connected in a network for many simultaneous users is not legitimate, because that proliferation is not designed into the program--even if the use of the program is entirely internal to each computer and the code never sees the surface of a magnetic disk.[12]

Licensing represents a major legal barrier to the use of single-user software on LANs, but it is a highly complex and unsettled area of contract law. Most legal experts in this area appear to support the right of software vendors to license rather than sell their products, thus putting them outside the scope of certain sections of the 1976 Copyright Act. [13]

One legal expert, however, writing in a recent issue of The Computer Lawyer, argues that when a user purchases a software package, the transfer constitutes a sale, not a licensing agreement. [14] Until the issue is settled, if at all, by the United States Supreme Court, suffice to say that persons using licensed single-user software on a LAN without permission from the vendor risk legal action.

The International Council for Computers in Education has issued guidelines for the use of copyrighted software on a local area network. These guidelines represent more hope than reality, however, with respect to the copyright issue. The hope is that software vendors will begin to acknowledge the growth of local area networks and supply software at a reasonable price for use in a multi-user environment--especially in schools. There is also the hope that schools in turn will honor the copyright limitations on single-user software while trying to reach accommodations with software companies--through some sort of licensing agreement--for network applications.[15]

It should be emphasized, however, that until more popular single-user applications software is available in network versions, or unless an agreement can be reached with the vendor for use of the software on a network, or until the courts settle the difficult legal issues surrounding software licensing and copyright, it is illegal to buy a single copy of a copyrighted or licensed software package and to copy it to a hard disk for use by several microcomputers on the network. Such action is also unethical.

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COMPUTER CONFERENCING: A NEW TOOL FOR EXCHANGING INFORMATION

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Picture these:

1. You've got a toothache and need a substitute on short notice so you can go to the dentist.
2. You're a faculty member and want some advice on whether to purchase a used Kapro for $600.
3. You're an instructor and suddenly you realize that you left something vital out of your instructions to your class about their assignment and you won't see them in class again until Monday.
4. You're the chairman of a campus committee and need to arrange a meeting time and place that all 10 members can agree on.
5. You're on sabbatical but you've got to finish that grant proposal you and your colleague back home have due next month.

I could go on, but I'm sure you've got the point. Some of these problems are potentially solvable by the use of telephone calls and mail, but we've all run up against the limitations of these traditional forms of communication. (Anyone for telephone tag?)

For over a year now, the Academic and Research Computing group of the Office of University Computing has been experimenting with computer mail and conferencing to facilitate the instructional and research activities of the faculty, staff and students at the University of Oregon. In this paper I am going to concentrate on conferencing. In particular I am going to share my experiences with one conferencing system, COM.

What is Computer Conferencing?

Both computer mail and computer conferencing involve the use of computers to create, send and receive messages. Computer/electronic mail is a fairly close analogue to campus mail. It is usually possible to send messages both to individuals and groups of individuals (distribution lists). It is also common to provide commands for forwarding mail to others, with or without comments. Several mail systems interface to networks such as BITNET, making it possible to send messages to people all over the world.

Computer conferencing provides these capabilities, but has some important additional features as well. Conferencing systems group messages together into conferences about particular topics, a much more powerful construct than a distribution list. For example, since messages are sent to conferences (rather than distribution lists), it is possible to post a message that will be read by someone who is not currently a member of the conference. This is not possible with a mail system.

In addition, conferencing systems give much more control to the receiver. You get to choose which conferences you join and thereby have some control of which messages you receive. While mail systems feed your mail to you in a first-in first-out (FIFO) fashion, conferencing systems go further and group your messages by conferences. As a result, one can read all the new mail in one conference before moving on to the next, or go directly to a different conference than your currrent one.

Conferencing systems also provide you with commands to skim your mail and to control the order in which you visit conferences. Finally, conferencing systems usually provide much more powerful commands for reviewing old messages. This capability, if present at all, is quite primitive in most mail systems, being limited to the ability to 'hold' a message until a future time.

In summary, mail systems are designed with simple interchanges among known individuals in mind. Conferencing systems, as the name implies, are designed to facilitate ongoing discussions among a group whose membership is subject to change.

What is COM?

COM is a conferencing system which was developed in Sweden and can be leased in the United States through EDUCOM. While there are only a few sites in the United States at present, there are quite a few in Europe. Currently COM can only be run on a DEC 1091 computer under Tops10 or Tops20. Portacom, written in Pascal, is in the beta-test stage for IBM/CMS and is being ported to most mainframes.

Each time you run COM, it checks to see if there are any new personal messages (called LETTERS) or new messages (called NOTICES) in the conferences of which you are a member and gives you a brief summary of the number and type. COM is completely command driven, with over a hundred possible commands. This makes it both powerful and potentially confusing to use. However, COM has been designed to make it particularly easy to read your new mail.

By pressing the return key without typing a command, you indicate to COM that you want the default command. The default command (which appears as the first in a short list that is displayed every time COM is ready for a new command) changes dynamically so that it is one which will either show you the next unread message, or take you to the next conference with unread messages. First you see any personal messages and then you see new conference notices, one conference at a time.

You can interrupt this automatic process at any point by typing a direct command. The most common departure is to use the COMMENT or PERSONAL commands to respond to the message just read. Messages created by COMMENT are treated as conference notices and can be read by any conference member, while those created by PERSONAL are treated as letters and can only be read by the addressee. Comments are linked to the commented message and labeled as "Comment on text ...". It is possible to see the original message at that point by using the REVIEW COMMENTED command. A whole string of comments on comments can be reviewed using REVIEW TREE.

Notices which are to stand alone, rather than be comments, are created using the NOTICE command, while LETTER creates a personal message. If you interrupt the reading of your new mail to send a message, you will resume reading where you left off.

You are only shown the new messages in conferences of which you are a member. One becomes a member of a conference by using the MEMBER command. A list of current conferences, sorted roughly by the level of activity (the most active ones are at the top), is available by typing LIST CONFERENCES. A brief description of the purpose of a conference is available by using REVIEW PRESENTATION.

Several types of conferences can be created. The most common type is OPEN. Anyone can join an open conference. Membership in CLOSED conferences is controlled by the conference organizer. Both open and closed conferences may be WRITE PROTECTED. All messages to write protected conferences are first routed to a person or 'super-conference'. Using this mechanism, a conference organizer can screen messages to the conference.

An Open Conferencing System/Bulletin Board

We originally became interested in computer conferencing as a tool for communicating within our own group, Academic and Research Computing (ARC). ARC is the group within the Office of University Computing that has primary responsibility for supporting those using computers in their teaching and research. Until recently that has mainly meant supporting our two mainframes, but we now put as much or more effort into microcomputer support.

For this rest of this paper, I am going to focus on the situations we encountered when we provided a conferencing system that was open to anyone who was interested in microcomputers. The problem we faced was a familiar one. How does a tiny staff, already stretched by having to support two different mainframes, support the startling variety of microcomputers our university community was purchasing and asking us questions about? A bulletin board for microcomputer users seemed like a great way to provide some of this support--help them help each other.

However, many microcomputer users didn't have accounts on the mainframe where the bulletin board program ran and had no particular interest in getting one! At first we considered opening an account with a public password that could only be used to run the bulletin board. What we wound up doing instead was taking advantage of our operating system's ability to allow some commands to be used without logging in. This had two big advantages:

1. It made it easier for people to access the BB. Instead of having to go through two log in processes, one for the DEC and one for the BB, there was only one. What's more, all that was necessary to start the process was to type BB.

2. It made it harder for hackers to abuse the system. By making BB a non-logged in program, the only programs hackers could run were other non-logged programs, something they could already do anyway!

Once the decision was made to implement the micro BB as a non-logged-in command (it could also be used when logged in), some other important questions about access still had to be resolved. Our systems people insisted on limiting the number of non-logged users both in number (5) and on the basis of system load (only when there are no more than 75 logged-in jobs).

Town and Gown: How Open to Be

More difficult was whether we would restrict access to university people or open it to the community as well. I argued successfully to open it up. There are two obvious advantages to an open system: good public relations and the potential of more varied input. I was certain that there were people in the broader community who would make important contributions toward achieving our goal of helping members of the university community make more effective use of their microcomputers.

This has proven to be the case. People from outside the university help university people solve their problems and vice/versa. A person with a problem or a question posts a notice in the HELP ME! conference or in the conference devoted to the brand of computer they are interested in. Response to such questions is very quick and helpful. From 70-90 people will read a message in Help Me within 24 hours after the message is posted. Within a week almost 200 people will have read the message. Usually at least one helpful response will appear as a comment within 48 hours, and often, within 24.

Because we believe quite strongly in the value of local user groups, one conference is devoted to news about their meetings. We also maintain a conference for announcements about other micro bulletin boards, both local and national, and a conference for sysops of area boards. In fact, our board has become a sort of central exchange for information about other boards, including a place for sysops to distribute passwords for their boards and warnings about the latest hacker attempts to abuse boards. They have been a valuable source of both support and advice as some of them have been running their own boards for years.

Problems in Managing a Conferencing System

The computer hacker is not just a creation of Hollywood. However, the biggest hassle has not been attempts to break the system or otherwise intentionally mess things up or be obnoxious. It has been personal communication styles. Here are three of the most troublesome:

1. First and foremost is 'motor-mouth': Has to comment on every message in the database. Usually one-liners and useless. Imagine your joy at signing on and finding you have 100+ new messages to read, most of them of the calibre of "So's your old man!"

2. Second is 'know-it-all': (Frequently a motor-mouth as well.) Likes to put people down and hates being criticized himself. Has to have the last word. Results are series of exchanges long on heat, short on light that beat the issue into the ground.

3. Third is 'lets-boogie': Looking more for excitement than anything else. Result is notices entered just to provoke responses. "Gee things are awful dull around here. Atari Rules! Comodor (sic) sucks!" Mix this with some motor-mouths and know-it-alls and you can guess the rest.

Note that none of these personality types is the exclusive property of teenagers or non-university people. In our case, it just happened that some of the worst offenders were both. Neither do I believe they are an exclusive feature of open systems. I suspect that any system that reaches enough people (in our case over 200 active users) is going to turn up some of these people.

The one persistent problem we have encountered is the use of the board to conduct real-time, 'party-line' style gab sessions. Since this kind of socializing is quite natural and probably even a good thing in a student environment, COM's inability to handle it gracefully is a serious problem for such situations.

Many computer bulletin boards or commercial systems like Compuserve and The Source have a 'chat' or 'CB' feature for real-time communication with the sysop or other people who are using the board at the same time. COM does not, but you can achieve the same effect by simply using the WHO command to see who is also using COM and sending letters back and forth.

Problem: the COM text database is fixed in size; once the maximum is reached, every time a new message, be it a public notice or a private letter, is written, the oldest message on the system is deleted. The result was to delete virtually all the public notices on the system! (In defense of COM, I should note that the designers assumed the main type of communication would be scholarly discussion, not rap sessions.)

The first time this happened, I simply pointed out what was happening and asked users to moderate their activity. This worked for a while. However, we still had a very high level of private mail activity among a small group of users. Less than 10% of the users were generating 50% of the messages, most of them private. The result was that public notices had a lifetime of about a month.

When the level of this activity rose to the point that public notices were being overwritten in only a weeks time, I decided it was time to intervene. I identified the most active people (one had generated more than 600 messages in only 8 days) and informed them that they were rationed to 20 messages a week.

Unfortunately, there is no automatic way to do this within COM. Instead, I have had to write a set of programs and 'macros' to track and identify problem users. Access is denied by changing the password.

It was also necessary to modify COM to make it possible to control access. Previously people entered themselves; now only I could add a new person. I also developed additional utility programs to reduce the amount of effort needed to enter new people into this more restricted system. Our 'open' system is now potentially closable.

Summary

We are convinced that conferencing is a very valuable tool and one that should be available at every educational institution along with statistical packages, database management systems and wordprocessing or other document preparation tools. However, there are three things one should keep in mind when deciding whether to provide COM or any other conferencing or bulletin board system.

1. Don't expect instant acceptance; be prepared to devote six months to a year to promoting conferencing using COM or any other conferencing system before significant impact is achieved.

2. If you intend to use a time-sharing system for this activity, you must either be willing to require people to get an account on the computer running COM or be willing to invest considerable effort, as we did, in circumventing this requirement.

3. If substantial numbers of students are going to use the system, it should either have an on-line 'chat' feature or a message database organization that makes it impossible for a few individuals to 'take over' the message space with their personal mail, unless you are willing to put effort into 'policing' such activity.

APPENDIX A

COM Strengths

1. A powerful and flexible set of commands (over 100).

2. Excellent for eliciting quick and brief responses from a group.

3. REVIEW COMMENTED and REVIEW TREE commands make it possible to understand cryptic comments or replies by retrieving missing context. (Lack of this capability is a continual problem when using NIH MAIL.)

4. All texts and passwords are encrypted.

5. Keeps useful statistics on system usage on both a global and an individual basis. (However, as these are cummulative, some extra work is needed to get a feeling for the rate at which activity is occuring.)

6. Commands are provided to enable the sophisticated system administrator to examine and change any part of the database. This makes it possible to recover from some of the bugs encountered.

7. Versions for most commonly used mainframes are under development (Portacom). Coupled with utilities for interfacing with networks and mail systems, this holds out the possibility of a common conferencing network for multi-mainframe institutions.

8. The developers of COM provide a conference on the Stockholm COM system where assistance in installing and operating your COM system is available. This is accessible through Telenet at a communications cost of around $20 an hour or through MAILNET; there is no charge for the use of the Stockholm computer.

COM Weaknesses

1. Many people find it hard to learn to use.

2. No capability to create sub-conferences. This leads to a confusing list of conferences when you have many active conferences.

3. Old text deletion strictly by age. Deleting unwanted text does not make the space available for new messages. Once the text capacity of the data-

base is reached, every time a new message is created, the oldest one is deleted.

4. Single file database--personal mail and conferences compete for space. No way to control the amount of text created by an individual or a conference.

5. Hard to use review capability.

6. Problems uploading files created by some popular WP programs, because of embedded control characters.

7. Statistics on conference activity are misleading because they show the total number of messages ever created, not those that are still available to be read or reviewed.

8. Has bugs. In particular, when some of the maximum parameters of the database are exceeded parts of it become corrupted rather than catching the problem.

APPENDIX B
Micro Bulletin Board Activity

Micros BB has been in operation for about nine months (as of June, 1985), six months of that it has been available on a non-logged in basis.

1. We currently have over 400 people enrolled.
2. New people are joining at a rate of about 20 a week.
3. Over 250 different people have used it at least once during the last month, 162 of them within the last week.
4. The average number of different people using it per day is about 75.
5. The average message length is four lines.
6. The average number of new messages created per day is 150.
7. The average number of lines added to the database per day is 600.
8. Over 50% of the new messages are created by less than %10 of the active users, and most of this is personal mail.

APPLEWORKS IN THE SCHOOL LIBRARY MEDIA CENTER

by Linda F. Erz

AppleWorks is an integrated software program which combines word processing (WP), database management (DB), and spreadsheet (SS) functions. It requires an Apple IIe or IIc computer with 128K. It is especially well-suited for the busy school library media specialist, for the following reasons:

1. Apple IIe and IIc computers are frequently used in schools
2. AppleWorks' three components allow for coverage of many library media center tasks
3. AppleWorks' ability to transfer data from one function to another (e.g. from spreadsheet or database to word processing) is particularly useful for library media center communications
4. AppleWorks' mnemonic-based commands, many of which serve similar functions in all three parts of the program, make it easier to learn and use than many other programs
5. AppleWorks provides the flexibility for the library media specialist to create special file and report formats to suit the needs of the individual situation
6. AppleWorks is less expensive than most programs offering similar functions (List price is $250 -- many schools can get it for around $170)

School library media center applications for AppleWorks fall into three general categories: management, instruction, and enrichment.

Management applications include:

1. Budgeting (SS)
2. Review/consideration files (DB)
3. Ordering (DB)
4. Accession lists (DB, SS)
5. Inventory recordkeeping: print, nonprint, AV equipment, texts (SS, DB)
6. Circulation recordkeeping (SS, DB)
7. Circulation: checkouts, overdues, individual reading records (DB, SS)
8. Letters, memos, other written communications (WP, with data from SS or DB)

Instructional applications include:

1. Lesson planning (WP)
2. Gradebook functions: student performance records, class records (SS, DB)
3. Student evaluation reports (WP, with data from SS or DB)
4. Handout and test design (SS, WP)

Enrichment applications include:

1. Bibliographies (DB)
2. Reference source lists (DB)
3. Storytelling/readaloud records (DB)
4. Class activity records (DB, SS)
5. Book and media reviews by media specialist and/or by students (DB)

The following pages include example templates for some of these functions. School library media specialists may find them useful as starting points for the design of formats that meet the needs of their individual programs.

Some books that may also be helpful to the media specialist who wants to make full use of AppleWorks include:

1. The APPLEWORKS TUTORIAL and APPLEWORKS REFERENCE MANUAL (these are purchased with the program itself)
2. The PRODOS USER'S MANUAL (purchased with the ProDos User's Disk, which is often included as part of an AppleWorks "package deal.")
3. Williams, Robert E. THE POWER OF APPLEWORKS. Management Information Source/Prentice-Hall, Inc. 1984. ISBN 0-13-688045-2. $19.95 (paperback). Teaches the capabilities of the program through extensive hands-on examples.
4. Matthews, APPLEWORKS MADE EASY. $17.95. Includes extensive explanations with especially thorough coverage of spreadsheet functions.
5. APPLEWORKS AND THREE E-Z PIECES. 1985.

AV EQUIPMENT INVENTORY (DB)

This database allows the media specialist to keep inventory, location, and maintenance records for all AV equipment in the same file. This has several advantages over the old "shelflist card" system. One is that the information is not subject to loss and disorder, as cards are (providing that backup disks are prudently kept). Another is that the information may be selected, sorted and rearranged by computer much faster than by hand. And AppleWorks' versatile reporting capabilities allow the media specialist to print out records in many different formats, selecting only the relevant information for a given need, and arranging it in any order desired.

For example, at budget and ordering time, it is very easy to call up information on equipment based on depreciation dates, making it simple to anticipate what will need replacing, and when. Maintenance records are always readily available, making it easy to establish a routine maintenance schedule. Data entry is always easy, due to AppleWorks' "Find" feature which allows instant access to the file on a given piece of equipment (no more searching through stacks of shelflist cards).

The following sample shows the categories as they might appear in a such a database. In this sample, all information is shown for the chosen piece of equipment. The media specialist can, of course, choose which categories will be printed in a given report, based on the information needed. Several examples of report formats follow on the next page.

```
Inventory #: MP-495           Equipment Type: 16mm Film Proj.
Brand: Bell & Howell          Model #: 3500     Serial #: 00730654
Bulb: DYS/DYV; exciter: BAK   Accessories: Speaker in lid
Date Purchased: Sep 83        Price: $700       Depreciate out by: Sep 90
Location in building: IMC                       Last Inventoried: June 85

MAINTENANCE RECORD:
 : 3/84: Sprockets tearing film
 : 5/84: Fluttering -- will not hold frames of film
 : 6/85: Cleaned lens
 :


Inventory #: S2A-257         Equipment Type: Auto. Slide Proj.
Brand: Kodak                 Model #: EktagraphicSerial #: 6827-01-3342
Bulb: ENH/ELH                Accessories: Remote control, zoom lens, 80-tray
Date Purchased: Mar 84       Price: $300      Depreciate out by: Mar 94
Location in building: Library Media Center    Last Inventoried: June 85

MAINTENANCE RECORD:
 : 6/85: Cleaned lenses, changed bulb
 :
 :
```

In this example of a "tables" report, only information that might be helpful in the inventory process has been selected for printing. With AppleWorks, the media specialist has complete control over which categories are printed, over the order and width of those categories, and over the way information in the categories is selected and arranged. This makes possible an almost infinite variety of custom-reports using the data contained in a single database. This allows significant savings of time and effort.

Inventory #	Equipment Type	Brand	Model #	Serial #	Location	Last Inventoried
MP-495	16mm Film Proj.	Bell & Howell	3500	00730654	IMC	June 85
S2A-257	Auto. Slide Proj.	Kodak	Ektagraphic 500	6827-01-3342	Library	June 85

The following "tables" report could be used as a maintenance record. It uses the same database as the other reports in this section, but different categories have been chosen for printing.

Inventory #	Location	MAINTENANCE RECORD		
MP-495	IMC	3/84: Sprockets tearing film	5/84: Fluttering -- will not hold frames	6/85: Cleaned lens
S2A-257	Library	6/85: Cleaned lenses, changed bulb		

The following is another format that might be used for equipment maintenance records. The advantage of this second format is that it can be printed on 8½ x 11" sheets or on cards for filing, if desired. This is a "labels" style report. As you can see, any categories not relevant to equipment maintenance have been deleted for this report.

Inventory #: MP-495　　Equipment Type: 16mm Film Proj.
Brand: Bell & Howell　　Model #: 3500　　Serial #: 00730654
Location in building: IMC

Bulb: DYS/DYV; exciter: BAK　　Accessories: Speaker in lid

MAINTENANCE RECORD:
3/84: Sprockets tearing film
5/84: Fluttering -- will not hold frames of film
6/85: Cleaned lens

BIBLIOGRAPHIES (DB, WP)

AppleWorks greatly simplifies the process of searching, compiling, up-dating, and typing bibliographies for teachers and/or students. Bibliographies may be compiled with the word processor or with the database. An advantage of using the database is that information can then be sorted and arranged according to any category (i.e. only books for a certain grade level may be desired, or books of a certain length). If the database is used for the basic bibliography, the information can always be transferred to the word processor for manipulation and printing.

The following sample entries from a typical database show some of the categories that might be used. With AppleWorks, individual category titles may be printed or not, according to the user's wishes. These examples were selected from a much larger database of good readaloud stories. The selection criteria were: (1) the stories must be about animals, and (2) the stories must appeal to adults. The resulting report was then "printed" into this word processing document.

ANIMAL STORIES WITH ADULT HUMOR

E Sylvester and the Magic Pebble
St Steig, William
Windmill 1969 Ages 7-adult

A young donkey named Sylvester is thrilled when he finds a shiny red pebble that grants every wish he makes, but one of his wishes leaves him in BIG trouble.

E Anteater Named Arthur, An
Wa Waber, Bernard
Houghton Mifflin 1967 Ages 6-adult

Arthur's mom describes 5 situations when Arthur is less than a perfect son: when he doesn't understand, has nothing to do, has a messy room, is choosy, and is forgetful.

E You Look Ridiculous, said the Rhinoceros to the Hippopotamus
Wa Waber, Bernard
Houghton Mifflin 1966 Ages 6-adult

Other animals tell the hippo she looks ridiculous because she isn't like them, but when she gets all their traits in a dream, she realizes she's REALLY ridiculous.

[It should be obvious that a similar database and report format could be used for compiling files of student and/or media specialist book reviews. Students familiar with the computer could search the database directly, or input data, while others could use the information in printed form.]

MANAGING BUDGET ACCOUNTS (SS, DB)

Often the library media specialist is responsible for ordering materials and managing funds for several different budget accounts. This entails a sizeable amount of bookkeeping, particularly in secondary schools.

Computer spreadsheets can save much time in working with these accounts, not only by doing all the calculations, but also by providing printouts easily and quickly at any time. Formulae built into the spreadsheet cause balances to be recalculated automatically any time new encumbrances or payments are entered.

The sample Language Arts Text Account below shows one way a spreadsheet could be used for these functions:

```
ACCOUNT    1121-421-578-10                    1984-85      APPROP: $3500.00
---------------------------------------------------------------------------
ORDER #    DESCRIPTION           COPIES  COST   ENCUMBERED   PAID   BALANCE
---------------------------------------------------------------------------
84/85-4    Bldg.Eng.Skls 6           75  11.32    849.00   867.50   2632.50

84/85-10   SRA Eng.Bk. Gr. 8         35  10.25    358.75            2273.75

84/85-19   Thm&Wrtrs-Focus Gr.7      55  10.89    598.95            1674.80
```

To be able to review at a glance the current balances in all text and library accounts, a database could be easily set up as shown in the following "tables-format" example:

```
SUBJECT           APPROPRIATION         ENC/PAID     CURRENT BAL.
---------------- ---------------   -------------   ---------------

Library Books           3500.00          1825.20          1674.80

Audio-visual Equipt     4300.00          3464.53           835.47

Audio-visual Matls      2500.00          2380.27           119.73

Library Supplies         400.00           365.05            34.95
```

BOOK REVIEW/CONSIDERATION/ORDER/ACCESSION FILE (DB)

Wouldn't it be nice to be able to read a book review, enter the information about the book in a database, and then be able to use the SAME database to establish ordering priorities, order books, and catalog and then publicize the books when they arrive? You can do it with AppleWorks' database.

The template below shows a typical record in a database that can be used for all of those functions, which are described in more detail on the following page:

```
File: Csdras.Ordr.Slp          REVIEW/ADD/CHANGE               Escape: Main Menu

Selection: All records


Record 2 of 2
================================================================================
Title: Trouble with Dragons                                    Priority: 1
Author/Ed/Comp: Selfridge, Oliver G.                   Quantity ordered: 1
Illustrator: Hughes, Shirley                           Date ordered: May 79.
Publisher: Addison-Wesley        Date: 1978            Date received: Sep 79
ISBN: 0-201-07458-3              Price: $7.95          Call number: Fic Se

Review source: SLJ 2/79 p108     Requested by: L. Erz
Category: Fairy tales                                SCHOOL: Forjay
Ages: 10-14                                          Account #: 2221-431-178-005
Notes: Humorous turnabout on a traditional fairy tale theme.
-: Three sisters take turns at slaying a dragon in order to win a prince's hand
-: Good readaloud with strong, non-traditional heroine
-: -
-: -
SPECIAL INSTRUCTIONS: Catalog as Fiction rather than 398
--------------------------------------------------------------------------------
Type entry or use @ commands                                        @-? for Help
```

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FUNCTIONS THAT CAN BE ACCOMPLISHED WITH THE DATABASE ON THE PREVIOUS PAGE:

1. REVIEW/CONSIDERATION FILE: Recording information from published reviews or personal previews. The "Notes" section could be used to summarize the critical review, or to make content notes that could later be used as an annotation in publicizing the book.
2. PRIORITIZING FOR ORDERING: Assigning a priority to the book for ordering purposes (For example, 1 might mean "top priority -- definitely order," 2 might mean "desirable if funds available," 3 might mean "nice to have but a luxury item." Books that are not considered to be desirable for purchase would, of course, not be entered in the database.)
3. ORDER SLIP: All information required for ordering can be filled in, with AppleWorks' standard values saving time on such categories as "Quantity Ordered," "Date ordered," "School name," and "Account #." By selecting only the relevant information for the chosen books (all those marked Priority #1, for example, the file can be used to print the actual order slips on multiple-part carbonless forms.
4. ACCESSION LIST: When books arrive (or if they're out-of-print, on back order, etc.) that information can be entered. At any time, the file can be printed in order by "Date received," providing an instant accession list.
5. ANNOTATED LIST OF NEW ACQUISITIONS: Records for those books that are ordered and received can be sorted by call number, and the appropriate information printed to the clipboard, for the word processor, to create an annotated bibliography of new acquisitions.
6. UPDATING SUBJECT BIBLIOGRAPHIES: If other subject-area bibliographies are kept in database files, records for newly-acquired books may be copied into those files, providing constant updates without new data entry. Or records for selected books may be printed to the clipboard, and then incorporated with bibliographies which already exist in the word processor.
7. MERGING FILES: Larger libraries will eventually want to sort their files by broad general category (e.g. Fiction, NF-800's, Ref, etc.). AppleWorks' flexibility in sorting, selecting, and arranging records and then moving them from one database to another makes this easy.

PRIORITIZING FOR ORDERING:

Suppose it's ordering time. All year long, you've entered all the relevant data for books under consideration as you've read the reviews, and you've assigned each computerized "review slip" a priority number. Now you'd like to be able to skim through your database and look only at specific information about those titles you've assigned a #1 priority to. You'd like to find out what it would cost to order all those books you've prioritized as #1. You'd like to be able to choose those you'll actually order now, and which you'll order later. Perhaps you'd like to see which books fall into similar categories, to assure a balanced order. You can do all of these things with this database.

Below is an example of a report that can be printed on paper or copied into another database which you've created for this purpose. In this case,

```
Pri  Title                              Category                    Price
---------------------------------------------------------------------------
1    Trouble with Dragons               Fic--Fairy tales            $7.95
1    Animal Farm                        Fic--Political satire       $1.25 pb
1    Rascal                             NF--Animals, Biography      $1.25
                                                                 -----------
                                                                  $10.45
```

ORDER SLIPS:

Suppose you've decided on which books to order, and you've entered the current date in each record as a way of identifying those to be ordered immediately. Now you want to print your actual order slips, so that they can be sent to your wholesaler, or directly to the publisher. AppleWorks allows you to sort your order by title, author, publisher, or any other category you specify.

The following example could be printed on a 3-part carbonless form for ordering from Baker & Taylor. In this case, books are listed in title order, but any other order could be specified. For example, if your library orders direct from publishers, all titles from each publisher could be grouped for easy mailing and record keeping. Use of a multiple-part form allows you to keep a hard copy of your order (though it hardly seems necessary) and to send copies to the accounting department, and to anyone else who needs a copy. [Of course, when school districts REALLY get automated, all you'll do is send a copy of your disk, or even better, you'll simply transmit your order via modem.]

Title: Animal Farm
Priority: 1

Author/Ed/Comp: Orwell, George
Illustrator:
Publisher: NAL Date: 1946

ISBN: Price: $1.25 pb Quantity ordered: 5

SCHOOL: Forjay Date ordered: May 85
Account #: 2440-431-890-005 Date received:

SPECIAL INSTRUCTIONS:

Title: Trouble with Dragons
Priority: 1

Author/Ed/Comp: Selfridge, Oliver G.
Illustrator: Hughes, Shirley
Publisher: Addison-Wesley Date: 1978

ISBN: 0-201-07458-3 Price: $7.95 Quantity ordered: 1

SCHOOL: Forjay Date ordered: May 85
Account #: 2221-431-178-005 Date received:

SPECIAL INSTRUCTIONS: Catalog as Fiction rather than 398

PUBLICIZING NEW BOOKS:

Your new books have arrived, and you want to send an annotated list to your staff and students. The brief bibliography uses information from the same database that was used to review, prioritize, and order the books. In this case, a new report format was created which shows only that information of interest to readers. AppleWorks allows you to lay out your report in any fashion you choose. The report can then be printed as is, or printed to the clipboard for incorporation in a word processor memo announcing the arrival of the new materials.

921 No Rascal
Author/Ed/Comp: North, Sterling
Ages: 8-adult
Notes: The author recounts his childhood, when his best friend was his pet raccoon, Rascal. A humorous, moving story.

Fic Or Animal Farm
Author/Ed/Comp: Orwell, George
Ages: 12-adult
Notes: Devastating political satire illustrating the results of establishing a communist totalitarian political/economic system. The human counterparts of the animals in the story are only thinly disguised.

Fic Se Trouble with Dragons
Author/Ed/Comp: Selfridge, Oliver G.
Illustrator: Hughes, Shirley
Ages: 10-14
Notes: Humorous turnabout on a traditional fairy tale theme.
Three sisters take turns at slaying a dragon in order to win a prince's hand
Good readaloud with strong, non-traditional heroine

* * * * *

CONCLUSION

I hope these examples have given you a good idea of the tremendous power and versatility of AppleWorks, and of some of the many possible applications of the program in the school library media center. If these ideas have been helpful to you, I'd like to hear about it. And if you've come up with new applications or further refinements of these applications, I'd like to hear about those, too. I'd be grateful to receive a copy of any templates that are developed for school library media center applications, so I can continue to "spread the word" that will help make all of our jobs easier!

Linda F. Erz
155 East 34th Avenue
Eugene, OR 97405

STATE-OF-THE-ART IN ADMINISTRATIVE SOFTWARE

By
Dr. Stanley Pogrow

Attached is a list of the companies producing full-featured administrative software for student management and financial management applications. Evaluations of these companies products are contained in the recently released: Evaluations of Educational Administration Software, published by ED-AD Systems, P.O. Box 22801, Tucson, AZ 85706 ($29.95 with shipping).

The major findings from the evaluations are that:

- Most users are generally happy with the systems they have purchased
- The quality of administrative systems have improved substantially over the past few years, but student management software is generally better developed than the financial systems
- There are substantial differences in the quality and features offered. A major difference in the student management systems is whether the system offers a four year on-line transcript or student demographic capability (few offer both). Another difference is that while most give a good bit of flexibility in generating reports, most simply allow you to break out reports by some pre-defined fields, but not on most demographic fields. In addition, query capabilities are generally limited, and few had integrated word processors.
- While most vendors were promising networked versions, few had actually been installed, and it will probably require more powerful systems such as the AT to support networking or timesharing.
- Virtually all the microcomputer administrative software is being developed for the IBM PC and compatibles. Apple IIs are just not presently sufficiently powerful.

I. STUDENT MANAGEMENT

Microcomputer Systems

CERF

Cerf
1441 North 27th Lane
Phoenix, AZ 85009

(602) 269-8817

Computer: Commodore 8032, TRS-80, IBM PC XT, (Apple Version Coming)
Available Applications: Attendance, Scheduling, Grade Reporting

COGITO II

Cogito Corporation
1101 State Road, Bldg. T
Princeton, NJ 08540

(800) 257-9513

Computer: Convergent Technology Micro (16 bit)
Available Applications: Attendance, Scheduling, Grade Reporting

COLUMBIA--THE SCHOOL SYSTEM

Columbia Computing Service
8611 South 212th Street
Kent, WA 98031

(800) 426-4824

Computer: Convergent Technology Micro (16-bit)
Available Applications: Attendance, Scheduling Grade Reporting

COMPUTER APPLICATIONS INC.

Computer Applications, Inc.
5150 East Pacific Coast #200
Long Beach, CA 90804

Computer: IBM PC XT, Fortune Micro and a variety of minis
Available Applications: Attendance, Scheduling and Grade Reporting

ED. ADMIN. DATA SYSTEMS--TSAS

Educational Administration Data Systems
P.O. Box 7005
Springfield, IL 62791

(217) 787-7190

Computer: Apple II with floppy/hard disk, IBM PC XT (Compatibles)
Available Applications: Attendance, Scheduling, Grade Reporting, Database

EDUCATIONAL TIMESHARING SYSTEM--SASI

Educational Timesharing Systems
144 Emerson Avenue
Orange, CA 92665

Computer: CP/M Systems, IBM PC
Available Applications: Attendance, Scheduling and Grade Reporting

ELLIOT

Elliot Software Systems
123 East Myrtle Street
Duluth, MN 55811

(218) 727-3763

Computer: IBM PC XT, Apple II
Available Applications: Attendance, Scheduling, Grade Reporting, Test Scoring, Media Materials Scheduling

ESSERTIER SOFTWARE--THE SCHOOL DIRECTOR

Essertier Software Corporation
1020 Manhattan Beach Boulevard
Manhattan Beach, CA 90266

(213) 546-5895

Computer: Apple II
Available Applications: Attendance, Scheduling, Grade Reporting

HARTS III

School and Home Courseware
301 East Mesa

Fresno, CA 93704

(209) 431-8300

Computer: Apple II with floppy drives
Available Applications: Attendance, Scheduling Grade Reporting, Letter Writing

INTEGRAL COMPUTER SYSTEMS--SMS

Integral Computer Systems
136 Main Street
Putnam, CT 06260

(203) 928-0451

Computer: CP/M Sytems, IBM PC, TI Professional
Available Applications: Attendance, Scheduling, Grade Reporting

INTERNATIONAL SOFTWARE SOLUTIONS

International Software Solutions
3355 Lenox Road
Durham, NC 27707

Computer: IBM PC XT
Available Applications: Attendance, Scheduling and Grade Reporting

JAC

JAC
76 North Weston Avenue
Orange, CA 92665

(312) 741-3555

Computer: Apple IIe
Available Applications: Attendance

LEARNING SOFTECH OF AMERICA

Learning Softech of America
139 South 52nd Street
Lincoln, NB 68510

(402) 483-2983 or 800-228-1492

Computer: IBM PC XT, Apple IIE
Available Applications: Attendance, Scheduling, Grade Reporting

MICROTECH EDUCATIONAL SYSTEMS--MISR

Micro Educational Systems
P.O. Box 258
Howell, NJ 07731

(201) 431-5539

Computer: TRS-80 Mod 11, 12, 16
Available Applications: Attendance, Scheduling, Grade Reporting, Test Scoring (Mod 16 only)

MICRO SOLUTIONS

Micro Solutions
1305 West 96th Street, Suite A
Durham, NC 27707

(317) 844-1184

Computer: Apple II
Available Applications: Attendance

MIDWEST SYSTEMS GROUP--CASTS

Midwest Systems Group
747-D Church Road
Elmhurst, IL 60126

(800) 222-3290

Computer: Burroughs B-22, 25 (Convergent Technology 16-bit micro)
Available Applications: Attendance, Scheduling and Grade Reporting

MOUNT CASTOR--CLASSIFIER

Mount Castor
51 Harbor View Lane, P.O. Box 488
E. Orleans, MA 02643

(617) 255-9520

Computer: IBM PC, Apple IIe, TRS-80 Mod III & IV
Available Applications: Attendance, Scheduling and Grade Reporting

OLYMPIA COMPUTING COMPANY--SCHOOLMASTER

Olympia Computing Company
7249 Capitol Boulevard South
Tumwater, WA 98501

(206) 352-0922

Computer: IBM PC XT (and compatibles)
Available Applications: Attendance, Scheduling and Grade Reporting

REDIKER SOFTWARE

Rediker Software
67 Genevieve Drive
Lincoln, NG 68510

(413) 566-3495

Computer: Commodore 8032 (IBM version under development)
Available Applications: Attendance (whole and half-day only, not period-by-period), Scheduling, Grade Reporting

SCHOOL OFFICE SOFTWARE SYSTEMS--ARS

School Office Software Systems
3408 Dover Road
Durham, NC 27707

(919) 493-3366

Computer: Apple II
Available Applications: Attendance with automatic home-dialing

SOFTWARE TECHNOLOGY-SSTS

Software Technology Inc.
3763 Airport Boulevard
Mobile, AL 33608

(205) 344-7600

Computer: Apple II, IBM PC
Available Applications: Attendance, Scheduling and Grade Reporting

TAMARAC SYSTEMS INC. (OSIRIS)

Tamarac Systems Inc.
9125 East Floyd Ave
Denver, CO 80231

(303) 696-1099

Computers: IBM PC, Apple Macintosh
Applications: Attendance, Scheduling, Grade reporting

Minicomputer and Mainframe Systems

AVATAR BUSINESS SYSTEMS

Avatar Business Systems
510 Market Loop Suite 102
West Dundee, IL 60118

(312) 428-3880
Computer: IBM System 34, 36, 38
Available Applications: Attendance, Scheduling and Grade Reporting

CENTURY CONSULTANTS

Century Consultants
339-D West Farms Road
Howell, NJ 07731

(201) 431-1592

Computer: Small-Super Mini, Timesharing
Available Applications: Whole-day Attendance, Scheduling, Grade Reporting, Test Scoring, IEP

J & K COMPUTER

J & K Computer
1255 West Baseline Road
Mesa, AZ 85202

(602) 897-7861
Computer: Small-Super Mini, Timesharing
Available Applications: Attendance, Scheduling, Grade Reporting, Library Management

MIDWEST SYSTEMS GROUP (MSG-CASTS)

Midwest Systems Group
747-D Church Road Court
Elmhurt, IL

(800) 222-3920
Computer: Burroughs 1900, 5900, 6900, 7900 IBM 4300
Available Applications: Attendance, Scheduling, Grade Reporting, Test Scoring

PACIFIC WESTERN INFORMATION SYSTEMS

1245 S. Winchester Blvd.
San Jose, CA 95128

(408) 246-4762

274

Computer: Prime
Applications: Scheduling, Attendance, Grade reporting

SIERRA SOFTWARE SYSTEMS

Sierra Software Systems
601 Montgomery Street, Suite 190
San Francisco, CA 9411

(714) 594-9418
Computer: Texas Instruments 300, 600, 900 Business Systems
Available Applications: Attendance, Scheduling, Grade Reporting, Test Scoring, Word Procesing and IEP Monitoring

SUN VALLEY SYSTEMS (WEATHERFORD)

Sun Valley Systems
1201 Kingsmill Avenue
Rowland Heights, CA 91748

(714) 594-9418
Computer: Texas Instruments 300, 600, 900 Business Systems
Available Applications: Attendance, Scheduling, Grade Reporting, Text Scoring, Word Processing and IEP Monitoring

SYSTEMS ELEVEN

Systems Eleven
One Pomperaugh Office Park
Southbury, CT 06488

(203) 262-6266
Computer: DEC PDP 11, VAX
Available Applications: Attendance, Scheduling, Grade Reporting, Test Scoring

II. FINANCIAL MANAGEMENT

AVATAR BUSINESS SYSTEMS

Avatar Business Systems
510 Market Loop, Suite 102
West Dundee, IL 60018

(800) 323-0803, (312) 428-3880
Computer: IBM System 34, 36, 38
Available Applications--Cost: Gen. Ledger, Accts.
Payable, Payroll
Inventory Control
Fixed Assets

INNOVAK INTERNATIONAL

Innovak International
P.O. Box 6308
Spartanburg, SC 29304

(803) 583-3960
Computer: IBM System 34, 36
Available Applications--Cost: Gen. Ledger
Accounts Payable
Personnel-Payroll
Fixed Asset Mgt.

INTEGRAL COMPUTER SYSTEMS (CAPPS)

Integral Computer Systems
135 Main Street
Putnam, CT 06260
(203) 928-0451

Computer: CPM-based micros, TI Professional, IBM PC compatibles
Available Applications--Cost: Budget, Gen. Ledger
Accts. Payable
Accts. Receivable
Personnel
Payroll
Inventory

J&K

J&K Computer
1255 West Baseline Road
Mesa, AZ 85202

(602) 897-7861
Computer: IBM System 34, 36, 38
Available Applications--Cost: Budgeting, Accts.
Payable
Personnel/Payroll
Inventory

Fixed Assets

MASBO COOPERATIVE CORPORATION

Masbo Cooperative Education
99 School Street
Weston, MA 02193

(617) 647-5500
Computer: Small-medium mini
Available Applications--cost: Gen. Ledger, Accts. Payable and Recv.
Payroll
Personnel

MIDWEST SYSTEMS GROUP B-20 SYSTEM

Midwest Systems Group
747-D Church Road Court
Elmhurst, IL 60120

(800) 222-3920
Computer: Burroughs B-22, B-25
Available Applications--Cost: Gen. Ledger, Payroll, Personnel, Fixed Assets
(Price not set yet for B-25)

MIDWEST SYSTEMS GROUP B 1900-7000

Midwest Systems Group
747-D Church Road
Elmhurst, IL 60126

(312) 530-6431
Computer: Burroughs B1900-B700
Available Applications--Cost: Budgeting, Gen. Ledger, Personnel, Payroll
Inventory

NATIONAL COMPUTER SYSTEMS

National Computer Systems
11000 Prairie Lakes Drive
P.O. Box 9365
Minneapolis, Minn. 55440

(800) 447-3269
Computer: IBM PC XT

ROBERT DAVIS & ASSOCIATES

RDA Systems, Inc.
Suite 750

3355 Lenox Road
Atlanta, GA 30326

(404) 261-2001
Computer: Apple, IBM PC XT, AT, TANDY, DEC Rainbow
Available Applications--Cost: Gen. Ledger,
Accts. Pay.
Payroll
Receivables

SUN VALLEY SYSTEMS

Sun Valley Systems
2 Penn Plaza
Suite 1500
New York, NY 10001

1201 Kingsmill Avenue
Rowland Heighs, CA 91748

(714) 594-9418

(516) 825-2775
Computer: Texas Instruments Mini
Available Applications--Cost: Purchas., Budget.,
Finan. Reporting
Fixed Assets
Stores Inventory
Payroll Personnel

SOFTWARE UNLIMITED, Inc.

Software Unlimited
2000 West 42nd, Suite C
Sioux Falls, S.D.

(605)334-0865
Computer: IBM PC XT, AT
Applications: Accounting, Payroll, Fixed Assets

SYSTEMS ELEVEN

Systems Eleven
One Pomperauq Office Park
Southbury, CT 06488

(203) 262-6266
Computer: DEC PDP 11, VAX
Available Applications--Cost: Budgeting, Acctg.,
Personnel, Payroll

TEST ANALYSIS AND DEVELOPMENT (MAPP)

Test Analysis and Development Corp.
2400 Park Lake Drive

Boulder, CO 80301

(303) 666-8651
Computer: Alpha Micro
Available Applications--Cost: Gen. Ledg., Budgeting,
Payables, Oper. Sys.
Personnel
Payroll
Fixed Assets
Billing

COMPUTER APPLICATIONS IN THE CLASSROOM USING THE PRINT SHOP, DAZZLE DRAW, AND NEWSROOM

by Brian James

The actual percentage of computer using teachers and students still seems to be embarrassingly small considering the number of years educators familiar with computers have been spreading the good word. The obvious blame for this is the lack of sound educational software and the fact that application software is often complicated and time consuming to learn and use. Too often when learning and using a piece of software is compared with what is gained in the end, it appears to many educators and students that the task may be easier if not better without the computer.

Bank Street Writer and other simplified word processing systems are changing this conception. These software products are relatively fast to learn and yield something that is actually saving time and improving the end result. Bank Street Writer is a great way to introduce students and teachers to positive and worthwhile computer use quickly and easily. Most often it will challenge the student or teacher to investigate other practical uses of computers.

Many other software products are coming to market using the "Bank Street" philosophy -- easy and quick to learn, yielding improved results over what was done before. Although they initially were marketed for home use, these products have been quickly picked up by educators as great ways to improve both their own and their students productivity. Three of these software packages will be discussed here: "The Print Shop" by Broderbund, "Dazzle Draw" by Broderbund and "The Newsroom" by Springboard.

The Print Shop

The Print Shop is the oldest of the programs discussed here. Released in 1984 by Broderbund Software, The Print Shop is now available for the Apple // family and the Commodore 64. Other software companies have released "work alike" versions of The Print Shop for hardware not supported by Broderbund. For example, "Print Master" by Unison provides most "Print Shop" options for the I.B.M. P.C. and I.B.M. P.C. jr.

The Print Shop may be used to print professional looking greeting cards, signs, letterheads and banners. These are all things that students and teachers often spend time doing by hand. Unless the student or teacher is particularly artistic, results of their hand work is often unsatisfactory.

The "greeting card" option could be used for invitations, announcements, thank-you notes and any other "card" type activity. The teacher can either design a card style for the students to use or have each student design their own card.

Uses of the sign and banner options are numerous. Students and teachers may make signs with announcements and instructions. Students may use the sign option to make report covers. Banners, long signs printed on continuous fan-fold paper, can be used for dance or assembly announcements or any other area where a large attention getting sign is needed.

The letterhead option provides a way to produce custom letterhead paper for a class or an individual students. The letterhead option is useful in assignments that have to do with letter writing or perhaps the foundation of a classroom or school newsletter.

The first page of the The Print Shop manual states, "The Print Shop is so easy to use, you don't need to read this manual. Just start up the program and follow the prompts. You, will be printing in minutes!" Unfortunately most users take this invitation literally and pass up two of the more interesting and useful options of The Print Shop-- Screen Magic and Graphic Editor.

The Screen Magic option allows teachers and students to load graphic images produced by The Print Shop or other compatible graphic programs and add text. These screens may be printed on paper or saved on disk. The other side of The Print Shop master disk contains sample pictures that may be used or edited. Screen Magic also contains a "kaleidoscope" option that produces a series of patterns that may be frozen and used as background for a typed message.

The Graphic Editor contained in The Print Shop allows students and teachers to design their own picture that may be saved and used later in a Print Shop sign, banner, greeting card or letterhead. Using this option the school or class mascot may be incorporated in a Print Shop production or perhaps a signature may be used in a design. A keyboard, Koala Pad, or joystick may be used to help create the graphic image. The Graphic Editor may also be used to modify one of the Print Shop Pictures that comes with the package. Unfortunately, The Print Shop Graphics Editor does not support the "mouse" input device that many have found easier to control than a Koala Pad or a joystick.

The Print Shop is an excellent example of software that needs very little initial instruction and provides an improved method of doing something that has been done before by hand. The computer becomes a means to an end and not an end in itself.

Dazzle Draw

Dazzle Draw from Broderbund Software is essentially a drawing program. At this time it is available only for an Apple //e with extended 80 column card or an Apple //c. The program is unique in that it uses "pull down" menus and tools similar to MacPaint for the Apple Macintosh. The program needs either a "mouse", a graphics tablet, a Koala Pad, or a joystick to act as an "artists tool" to draw the pictures. Best control is by use of the "mouse" or "Graphics Tablet" which seems to come closest to an artist's manipulation of a pencil or brush.

The Dazzle Draw menu contains aids to making squares, lines, circles and a variety of drawing patterns and styles. Colors may be used on screen which are translated to shades when printed on a black and white printer (the program also supports color printers). The Dazzle Draw menu also contains an option for a limited number of text fonts, mirror and picture moving or repeating controls.

Although the obvious use of "Dazzle Draw" is for students and teachers to create pictures, because of the many menu options, the program should not be limited to creative drawing. The line and text options can be used to make tables needed to be included in reports (or just to learn about tables). Teachers may easily construct a graphic seat chart that may be easily changed and reprinted as students change. The circle, line, shade, and text options can make pie charts. The rectangle command will help students with bar graph assignments. As with The Print Shop, Dazzle Draw can help produce signs and letterheads. The program can also be used in music composition. Just about any graphics assignment that may have been somewhat frustrating and time consuming by hand drawing may become easier and more precise with Dazzle Draw. Students are able to spend more time with the substance of their presentation instead of worrying how to draw a circle.

The key to the importance of Dazzle Draw, as with The Print Shop, is that a long instruction period is not needed to begin producing something of worth. Perhaps the biggest obstacle to learning Dazzle Draw is not the program itself, but the manipulation of the "artist tool." It takes a few hours of practice for students and teachers to smoothly operate a "mouse" or a joystick.

The Newsroom

The Newsroom, released recently by Springboard Software, allows students and teachers to create a newspaper. Menu options include headlines, graphics, word processing, layout, printing and communications. The current version of The Newsroom operates on the Apple // family of computers. Future versions are planned for the Commodore 64 and I.B.M. P.C.

The Newsroom differs from The Print Shop and Dazzle Draw in that the student or teacher using the program has to pay more attention to the documentation. A practice period of a few hours is also recommended so that the user can experiment with layout procedures. Students or teachers may draw their own pictures using a graphics program based on "icons" similar to those found in MacPaint for the Apple Macintosh environment or they can use the large library of ready made graphics included. The Newsroom can be used by students to produce school newsletters or by teachers to create fancy hand-outs. The advantage of using The Newsroom over traditional cut and paste is basically easy mixture of graphics and word processing. Text fonts may also be changed to simulate headlines and banners. The instruction book also contains a tutorial on news writing and newspaper jargon.

Perhaps the most unique function of The Newsroom is the communications section. Newsletters may be transferred via modem to other classrooms through the telephone lines. Programs written in one city using the Apple // may be transmitted to another city using I.B.M. or Commodore 64 hardware complete with graphics. The students have a chance to create Newsroom Pen Pals and actually use computer telecommunications.

CONCLUSION

The Print Shop, Dazzle Draw and The Newsroom all represent an exciting new generation in educational software. They are important in that they produce a product not easily done by most students and teachers by hand. Students and teachers need to spend a minimum time to learn the programs. The substance of the exercise becomes more important than the fact that it happens to be computer aided. The computer is simply a tool to achieve an end more easily and quickly. Perhaps, with more programs following this philosophy, we will see a much higher percentage of computer using teachers and students.

List of programs featured:

"The Print Shop" by David Balsam and Martin Kahn, produced by Broderbund Software, Inc. Apple //, //e, //c, Commodore 64 $49.95.

"Print Master" distributed by Unison, IBM P.C. and IBM P.C. jr. $59.95.

"Dazzle Draw" by David Snider, distributed by Broderbund Software, Inc., Apple //e (128K), //c , $59.95

"The Newsroom" distributed by Springboard Software, Apple //, //e, Apple //c, Commodore 64, IBM PC, IBM PCjr. $49.95

CLASSROOM MANAGEMENT TOOLS:
GRADE BOOKS AND PROGRESS REPORTS

Nicholas Cofsky Sky

Current trends in educational computing indicate that computers are increasingly being used as tools for learning, problem solving, communication and classroom management. As the role of computers in education changes, there will be less emphasis toward computer assisted instruction, drill and practice, and programming. The purpose of this paper is to familiarize educators with currently available electronic gradebooks and progress reports, establish criteria for selecting classroom management software, and discuss current issues concerning using computers for classroom management.

Electronic Gradebooks

During the last six months I have developed a data base of currently available computer gradebooks. In February and March, I visited Portland State University Media Library, St. Martins College Media Library, and local vendors (QUDEX, Byte Shop, and The Computer Store) to preview and research current electronic gradebooks. Eleven electronic gradebooks were previewed and information on 40 additional gradebooks were gathered by reviewing catalog descriptions and writing to software distributors. The purpose of the search was to determine the current "state of the art" of gradebooks and to either select or design a gradebook for my dissertation.

I am interested in determining if electronic gradebooks save teachers time in keeping records, are more useful to teachers than traditional gradebooks, and if the information provided to students from computer based gradebooks help motivate students and increase their performance.

Literature Search

Research on computer based classroom management is sparce. Review of literature produced only one reference. In 1984, Germundsen and Glenn conducted a pilot study on teacher, student and parent attitudes toward computer based gradebooks. In the study six teachers used a computer gradebook called Gradepoint to keep student records. The teachers "felt that the computer gradebook was more useful than the old method of keeping grades ... however, (the computer gradebook) did not save time for the majority of teachers." Students and parents felt positive toward the information produced by the gradebook.

Criteria for Software Evaluation

Criteria used to preview the gradebooks were established to insure consistency of evaluation. They included the following general areas: ease of use, grading, output, progress reports, size limits, and documentation.

To determine ease of use, I looked for clear and well organized screen displays, help screens, default responses, logical sequencing of modules, clear instructions within the program, and speed of processing. In addition, I noted if the screen display used 80 columns.

Size limits included computer memory requirements and maximum number of classes, students, and assignments the program could handle.

To determine grading flexibility and accuracy, I looked for the ability of the instructor to determine his/her own criteria for grading, grading distribution, and grading weights. In addition, I favored programs that allowed the user to set their own grade variables, ie. the program was not locked into the traditional 'A' thru 'F' grading system, but allowed use of words, numbers or other symbols. Each program previewed was checked for computational accuracy.

Output was evaluated for organization, choice, and clarity. Gradebooks that produced statistical analysis of data were noted. Since some programs were not able to access a printer, I included printer access as a criterion.

Programs that were able to produce progress reports were evaluated for flexibility (could the teacher input comments for individual students), content, and ease of use.

Documentation, if available, was evaluated for readability and accuracy.

Results

Fifty one gradebooks were previewed and/or researched. There were 34 programs available for the Apple II series computers, 16 programs for Radio Shack computers, 9 programs for Commodore PETs and 64s, and 12 programs for other computers (IBM, TI, Atari, Heath/Zenith, and Franklin).

I found that most gradebook programs were poorly presented, slow to use, and had very poor documentation. Most of the programs were not flexible. The user was unable to change grading distribution and criteria. Only five gradebooks were able to generate progress reports.

Of the eleven programs previewed, five gradebooks were determined to meet most of the criteria mentioned above and are described below.

Software Review and Sample Output

The Recordkeeper, ASIEP Education Company, Portland, Oregon, $59.95.

The Recordkeeper prints sorted and/or alphabetized lists for each grading criterion, average grade, class, counselor, year in school (raw score or percent). The user selects up to 5 category headings to be printed. Progress reports contain comments (general & individual) supplied by the user. Grading scale easily modified (can use words or letters). Very easy to use. Good documentation. Slow.

^^^

Sample Table from The Recordkeeper:

```
PERIOD: 1                                       SUBJECT: SCIENCE
AUGUST 21, 1985                         INSTRUCTOR: NICHOLAS SKY

   STUDENT NAME            TESTS     LABS     AVE SCORE    GRADE
================================================================
1. BABE RUTH                73%       88%        82%         B
2. RICHARD ZIMMERMAN        76%    NO SCORE      76%         C
3. MARY DECKER              63%       40%        43%         F
4. ALFRED NEWMAN            88%      100%        95%         A
5. GRACE KELLY              77%       76%        77%         C

AVERAGE SCORES              75%       76%        75
```

Sample Progress Report from The RecordKeeper:

```
ADVISOR: JONES                                    ALFRED NEWMAN
PERIOD: 1                                       AUGUST 21, 1985

                  PROGRESS REPORT: SCIENCE

                     LATEST        TOTAL          GRADE

          TESTS        84%          88%             B
           LABS       100%         100%             A
       HOMEWORK        97%          94%             A
       PROJECTS     NO SCORE     NO SCORE           -
     ATTENDANCE       100%         100%             A

COMMENTS:

ALFRED, YOUR AVERAGE SCORE IS *** 95% ***.  YOU ARE EARNING
AN 'A' GRADE.  PLEASE HELP IN THE TUTORING CENTER THIS WEEK.
THIS IS THE LAST WEEK IN THE TERM.  DON'T FORGET THAT YOUR
FINAL PROJECT IS DUE BY AUGUST 28TH.

                                   NICHOLAS SKY
```

^^^

<u>Gradebook Plus</u>, Educational Microcomputer, San Jose, CA., $49.00.

Gradebook Plus provides an individual teacher with a gradebook that keeps records and generates statistical information for an entire class on a test, or any student in a class. Reports can be printed by student, class, or assignment and include complete statistical information and use a teacher defined grading scale. Schoolwide license for copying: $125.

Sample Output from Gradebook Plus:

```
BANCROFT, ANN

SCORES AS OF: 8/21/85

  (1)  MAG ARTICLE: 22/22
  (2)  QUIZ 1: 12/15
  (3)  CH 1 EXS: 17/20
  (4)  CH 1 WB: (  )
  (5)  CH 2 WB: 49/50

* '(  )' INDICATES A SCORE IS LEFT OUT.

TOTAL POINTS: 100/107
              93%
```

^^^

<u>Report Card</u>, Sensible Software, Oak Park, MI.

Quick program. Prints class averages, student scores, criteria, individual assignments/student, and grades. Program can duplicate class roster for different classes with the same students. Program does not produce a progress report. This is a easy program to use.

^^^

Sample Table from Report Card:

```
                    CLASS: SOCIAL STUDIES PM

                    CLASS TABLE OF GRADES:

             ACTIVITY #   1   2   3   4   5   6   7  AVERAGE
             ==========  === === === === === === ===  =======
1: ELMER FUDD             50  60   0  50   0  75  --    39.2%
2: KATHRYN HEPBURN        90  60  85  80   0  50  45    58.6%
3: SUZIE CREAMCHEESE     100  75  80  90  75  90  80    84.3%
4: HARRIET TUBMAN        100 100  65  60   0  50  15    55.7%
5: LEW ALLSINDOR          60  65  90  80  75  90  10    67.1%

                       CLASS AVERAGE:60.99 %
```

The Gradebook, Condor Computing, Dane, WI.

Prints individual and group reports. Individual reports contain each assignment and grade received. Group reports contain percent score for each student, class average, & std dev. Also prints bar graph! Allows for individual progress reports comments by stopping at each student's report. Slow, but easy to use.

Kalamazoo Teacher's Record Book, Hartley Courseware, Inc., $69.95.

Prints bar graphs for all assignments. Automatic re-entry of duplicate class lists. Listings of number of A's, B's, C's, etc. on any assignment by changing score range. Inclusion of extra credit points in grade averages. Computer generated codes for posting scores. Good documentation.

References

Gernundsen, Richard and Glenn, Allen D. "Computer Gradebooks: Implications for Teachers." The Computing Teacher, vol 12, no 2, October 1984, pp 13-15.

THE MICROCOMPUTER AS TEACHER'S AIDE

by George Beekman

Computer hype is everywhere these days. Advertisements, articles, and TV talk shows are bombarding us with messages telling us how a computer is quickly becoming an essential desktop appliance in every American office, school, and home. The business community has accepted computers as necessary tools, and schools are embracing them as much as their budgets will allow. But machines haven't yet penetrated into the majority of homes, in part because the average American believes that a home computer isn't useful enough to justify an investment of a thousand dollars or more.

The truth is that home computers in their present state don't offer sufficient value for the money for a typical consumer. Computers are information processing machines, and today's microcomputers are most useful for people who work with particular kinds of information -- most notably, numbers and written text. And the average American in the 1980s doesn't write, read, or calculate enough to be tempted by a machine that simplifies that kind of work. But teachers, who work with information all the time, are a different story. One of today's easy-to-use, powerful micros can potentially make any teacher's work more effective, easier, and more fun.

Choosing a Computer

Accept for now the idea that you have something to gain by buying a computer. Which computer should you buy? With a tremendous array of choices that's constantly changing, there's no simple answer to that question. But the important issues are easy to delineate:

- Capability: Can it do what I want it to do? The traditional technical questions (does it have enough memory, is the processor fast enough, etc.) aren't as important as they used to be because the marketplace forces have eliminated most of the computers that lacked the essential hardware features. Even the discount store "disposable" computers typically sport full-travel keyboards, 64 to 128K of memory, and adequate display for the kinds of things that most teachers will be doing. (The one big exception: cheap computers often limit display to 40 characters per line on a screen, making it impossible to view a page of text on screen exactly as it will appear on standard-sized paper. That's not crippling, but it's certainly inconvenient.)

- Compatibility: Will it run the software that I need? Computers aren't like stereos; you can't always run software from one type of machine on another brand. So it's important to know before you buy what software can be used on the machines you're considering. If you'll be using the school computers in your teaching, you'll want to seriously consider buying a brand that's compatible with those computers -- so you can do your computing at school and at home without transporting a machine; so you can try/use software at home from the school's library; so you can create assignments and examples on your home computer for use at school; so you can avoid having to learn the ideosyncracies of two different systems; so you can get help from your colleagues and students. On the other hand, compatibility shouldn't be overrated in your choice. Standards are fickle; the business world's current IBM-mania is just the most recent, and probably not the last. And while it's true that buying a "standard" machine opens software doors, it's not clear that most of us need all of those choices. Is it really important to have 100 word processors to choose from?

- Ease of use (AKA "User Friendliness"): Will it demand more of me than I want to give? How long will it take to learn to use? How often will I have to use it to keep from getting rusty? Will I spend most of my time in front of the machine with my nose in a manual?

- Transportability. How easy is it to move from home to school and back? This isn't important to some users, but it's critical for others.

- Price: Can I afford it on a teacher's salary? There are several questions hidden inside this one: How much do I need to invest outright? Will that $150 computer end up costing $1000 by the time it's up and running? How much will I have to spend for software after I've bought the box? Does my investment have a future, or am I buying a soon-to-be orphaned Banana PCjr 9000?

With these factors in mind, the best available alternatives are

- Apple IIe/c: not state-of-the-art, but a good bet for teachers who use them in school.

- IBM PC or one of the many compatibles: not state-of-the-art either, but its establishment as the darling of the Fortune 500 makes it the best bet for folks wanting to maximize software choices.

- Commodore 64/128: the best cheap alternative. The new 128 is almost certainly worth the extra money because it corrects many of the 64's problems.

- TRS-80 Model 100 or 200: a no-frills computer that fits in your briefcase.

- Apple Macintosh: almost state-of-the-art. The clear choice if ease of use and power are more important than compatibility with your school's fleet. (In fact, don't be surprised if your school's fleet is replaced by Macs or something like them in a few years.) The Mac is the first affordable computer that you can learn to use in an hour (slightly longer if you don't open the manual). Since almost all Macintosh software is designed with a consistent user interface, you don't need to learn a completely new set of tricks when you switch to a new program. If you can't afford a Mac, watch for promised Mac-alikes from Commodore and Atari.

Choosing Software That Can Work For You

There are hundreds of computer programs being sold as teaching helpers: programs to help you design tests and class schedules, programs to keep your gradebooks on disk, programs to generate crossword puzzles and trivia quizzes. While many of these special-purpose programs are marvelous tools for teachers, others are handicapped by three problems:

- Since each program has its own operating instructions, it's often confusing to switch back and forth between different programs. The more programs you have in your library, the worse the problem.

- When all of the preliminaries are taken into account, it's often less convenient to use a program than it is to do the job with a pencil.

- You may not use narrow-minded programs enough to justify the (often considerable) cost.

General purpose programs are another matter; these programs are versatile enough that they can be tailored to fit the needs of many a teacher.

Most of the "serious" jobs that microcomputers do fall into one of three categories: word processing, numeric calculation, and data storage and retrieval. So a software library that contains a word processing program, a calc-type spreadsheet program, and a database management program is well-equipped to handle most situations. But the lines between categories are blurring as companies release integrated packages that combine several functions in a single program.

Working with Words

The most important program in almost any teacher's library is a word processor. A good word processor allows even a hunt-and-pecker to easily produce copy that looks like it was generated by a professional typist -- or a professional typesetter. But more importantly, a word processor strips away most of the drudgery from the writing process, in the same way that a food processor eliminates much of the tedium from making a vegetable stew. Bothersome details like margins, spacing, layout, page numbering, centering, indentation, and underlining are all taken care of automatically by a good word processor.

Teachers spend a large part of their typing time doing repetitive tasks: setting up margins, tab stops, and headings so this handout will look like the last one; retyping the class information at the top of each page of a handout; retyping an old multiple-choice test question in a slightly different form for this test. Those repetitive parts of the job are the first places to look for help from a computer. Rather than setting up all of that formatting information each time you type a class form, you can set it up once and store a blank copy of the form on your disk for recall whenever you need to type a new form. Instead of retyping your name, the class name, the date, and the page number at the top of each page of a handout, let your software do it for you when it prints the document. Rather than retyping old test questions, take advantage of the options of your word processor that let you electronically "cut" or "copy" a question from an old exam stored on disk (or from a centralized bank of questions) and "paste" it into your new exam without ever typing a letter.

Not all word processing programs can do all of these things. And among those that can, some are much easier to use than others. There's a tremendous variety of word processors, so it's important to shop around enough to know you're getting what you need in a form you can use. Don't assume you need WordStar because that's what many pros use; WordStar has features galore, but it's terribly unfriendly to casual users who haven't memorized the complicated keystroke-commands that make it go.

The next generation of word processors should look more like MacWrite, an amazingly easy-to-use program that shows you on the screen exactly what your printed text will look like on paper. MacWrite also allows you to choose the font (type style) and size of every letter in your document, so you can visually liven up handouts and type beautiful large-lettered overhead transparencies and bulletin-board posters. Programs to simulate these capabilities (The Print Shop, Fancy Font) are available on other systems.

Most word processing programs don't check your spelling for you. But proofreading programs will. A spelling checker can, in a minute or so, take text generated on a word processor and look up every word in a dictionary-on-a-disk, pointing out each one that it can't find so that you can decide whether it's an error or just an esoteric word or name that's not in the dictionary. You then have the choice of changing the spelling in the text (if it was an error), adding the name to the dictionary (if it's a correctly-spelled word that you're likely to use again), or doing nothing (if it's a word you don't often use). Of course, a spell-checker is no substitute for human proofreading; it won't tell you that you typed "food" when you meant "good", or that your correctly spelled words don't make any sense together. But for little spelling problems, it's a big help.

Maybe spelling is easy for you, but you never make it to that stage because you get bogged down in the preliminary "Where do I start?" aspects of writing. It's nice to know that your word processor will always let you change your mind without starting over. But a newer kind of program, called an "idea processor" or "outline processor", makes organizing a test, handout, or lecture even easier by allowing you to drag whole ideas around in an outline until the organization is right. The most popular of these programs, Think Tank, is available for most micros.

All of these writing aids are of little value if you haven't mastered the keyboard. Fortunately, there are several good programs on the market that can teach you and your fingers to type.

The best thing about electronic writing aids like word processors, spelling checkers, and idea processors, is that they free the writer to concentrate on the words and the ideas rather than on the technicalities of the medium. Writing with a word processor is not only easier, faster, and more accurate -- it's a whole new form of creative expression.

Working with Numbers

A calc-type spreadsheet program does for numbers what word processors do for words. A good calc program can make short work of almost any job that involves repetitive calculations: budgeting, checkbook balancing, menu conversion, teacher gradebooks, student math/science projects and drills, and so on. The original program in this genre, Visicalc, was designed by a business student to automate the recalculation of rows and columns of numbers in corporate financial planning. Spreadsheet programs like Visicalc have become a staple of business computing, and the software shelves today are crowded with Visi-clones. Like word processors, these programs vary in size, features, friendliness, packaging, and promises. But in spite of their differences, they are similar enough that once you become familiar with one of them, you should have little trouble working with other brands.

All spreadsheet programs are based on one simple concept: the malleable matrix. All the cells of the matrix are empty when you start; it's up to you to fill them. Each cell can contain either a number, an alphabetic label, or a formula that computes a value based on the contents of other cells (e.g., the sum of the first three numbers in this row, the average of all of the previous numbers in this column, or even a particular letter grade depending on the number in the previous cell). Formulas can be replicated down columns or across rows, so repetitive structures like student gradebooks can be built quickly with a few keystrokes. Numerical values can generally be displayed in a variety of formats, from dollars-and-cents to simple bar graphs. It takes some skill and practice to set up the formulas for a complex spreadsheet, but once the formulas and labels have been established you can save the empty template and re-use it as many times as you need it.

The best spreadsheet programs allow you to easily sort data rows in any order, so you can put data for one student in each row of a gradebook worksheet and quickly sort the rows alphabetically, by student number, or by class ranking. But the biggest convenience of a spreadsheet/gradebook is the instant calculation feature that constantly keeps point totals up-to-date. When an error turns up anywhere in the gradebook, simply typing over the bad entry with the corrected number triggers recalculation of every relevant sum and average in the whole sheet. What could be easier?

Spreadsheets sometimes contain options for producing pie, bar, or line graphs to illustrate to the numerical relationships in the grid. Those that don't often can be supplemented with stand-alone graphics programs that can accept spreadsheet data as input and produce graphs as output. These programs, often called business graphics programs, serve a completely different purpose than the MacPaint-style programs that allow you to draw pictures on the screen using a mouse or joystick. Paint programs that make it easier for non-artists to create drawings are wonderful tools for making posters, illustrations, and any other kind of graphic display built around creativity rather than columns of figures.

Using Your Computer as a Filing Cabinet

Many teachers prefer to keep their gradebooks using database management programs instead of spreadsheets. Database programs are designed to facilitate the storage and retrieval of various kinds of information. It's up to you to organize the data the way you'll need it. For a typical gradebook you'd define a file made up of one record per student, with each student record containing name, ID number, and grade information. A good program will allow you to do simple calculations on fields (probably not as elaborate as the kind you can do with a spreadsheet), sort records in various ways, and search for particular values in the database.

A generic database can be used for storing any kind of information: lecture notes, teaching resources, administrative records, student histories, etc. But before any database can be useful, you have to be willing to take the time to type in the data. For many applications (and for many teachers), the convenience of electronic filing isn't worth the bother of data entry.

There's a wide range of choices for database seekers. It's important to find a program with the features you need, but it's just as important to find one that's easy to use. Try before you buy.

Beyond the Big Three

When you're setting up your software library, don't overlook the integrated packages that combine several functions in a single package. It's handy to be able to switch quickly between different applications, and it's convenient to have those applications all respond to the same commands. But be aware that many integrated packages make serious compromises in individual applications, and that the word "integrated" is abused by advertisers almost as much as the phrase "user friendly".

What about writing your own programs to store student grades or drill students on math or . . . ? Creating your own applications using BASIC, Pascal, or Logo can be fun and educational (for you, as well as your students). In addition, it gives you the freedom to create exactly what you need (within the limits of your system and skill) rather than what software companies think you need. But don't expect it to save time, and don't expect it to be easy. If you're looking for ways to make your work easier, leave the programming to the pros and stock your software library with the fruits of their labors.

Suggestions for Further Reading:

Beekman, George. *The Commodore 64 Home Companion*. Northridge, CA: Datamost, 1984. 359 pages.

Beekman, George. *The Macintosh Home Companion*. Northridge, CA: Datamost, 1985.

Beekman, George, and Corliss, Dennis. *The Apple Home Companion*. Northridge, CA: Datamost, 1984.

Beekman, George, and Folts, Jim. *The IBM Home Companion*. Northridge, CA: Datamost, 1985.

CAN COPYING SOFTWARE BE FAIR USE?

Jim Pollard
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The growing volume of analysis of how the copyright law (that is, the 1976 Copyright Act, P.L. 94-533 and the 1980 amendment of that act, P.L. 96-517) should be applied to the copying of software can be summarized by the word "no." The consensus is that only the narrowest interpretation of the Act should be considered and that even making the permissible "archival copy" of a program should be approached with a tremor since legal copying seems to breed illegal copying.

There is precedent, however, for a more lenient view of the copyright law. The Copyright Act does allow for some copying under the Fair Use section of the law (Section 107). That section states:

> Notwithstanding the provisions of Section 106, the fair use of a copyrighted work, including such use as reproduction in copies or phonorecords or by any other means specified by that section, for purposes such as criticism, comment, news reporting, teaching (including multiple copies for classroom use), scholarship, or research, is not an infringement of copyright. In determining whether the use made of a work in any particular case is a fair use the factors to be considered shall include--
>
> (1) the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes;
>
> (2) the nature of the copyrighted work;
>
> (3) the amount and substantiality of the portion used in relation to the copyrighted work as a whole; and
>
> (4) the effect of the use on the potential market for or value of the copyrighted work.
>
> (17 U.S.C. Section 107)

Two sets of guidelines have been published to assist in deciding whether a particular use of copyrighted materials is within the realm of "fair use." For print materials, the guidelines prepared by the Ad Hoc Committee of Educational Institutions and Organizations on Copyright Law Revision have been accepted by the courts and by the House of Representatives. These guidelines emphasize the use of a limited portion of a work and a concern that the cumulative uses of copyrighted works in a particular class are not excessive. The guidelines allow the copying of print materials if they meet the following conditions:

Poetry Complete poem if less than 250 words
Not more than two pages
Not more than 250 words from longer poem

Prose Complete work if less than 2500 words
Excerpt of 1,000 words or 10% whichever is less
500 words even if that is more than 10% of the work

Illustration One per book or periodical issue

Special Works (e.g., children's books) Not more than two pages.

A second set of guidelines was prepared by an ad hoc committee advising the House Subcommittee on the Courts, Civil Liberties, and the Administration of Justice (Helm, 1984). These "Guidelines for Off-Air Recording of Broadcast Programming for Educational Purposes" allow the copying of copyrighted television and radio programs. As opposed to the print guidelines, the broadcast guidelines allow the entire work to be copied. The most critical test of whether copying is within fair use are in (1) how long the tapes are preserved (less than 45 days) and (2) who requests their production (individual teachers).

The broadcast fair use guidelines are similar to those which are needed to govern fair use in educational copying of computer software. As with broadcast programs, the entire work should be copiable and restrictions should be placed on the duration of their use rather than the extent. Let's look at some situations where fair use guidelines might be written to permit copying.

Teaching about applications

In this use of software, a general purpose application such as a data base management program is used for a portion of a class to instruct students on what the program does and how it works. The copying of a program in this situation would not reduce the potential market for which the program was written--users of data bases--since in this situation they are not users of data bases but rather learners.

To draw a parallel, a student who uses a data base to learn geography using search and sort routines, selecting data, etc. is a data base user. Any commercial program that a student uses must be purchased since copying would reduce the potential market. A student who uses a data base just to find out what a data base does is not in that market, however, and fair use guidelines might be written to support that distinction.

Training Teachers

Fair use guidelines might also recognize that in training a teacher how to use a particular program in instruction, the program is being used in a way completely different from its intended use. The teacher does not use a math drill and practice program to learn math, but to learn about that program.

Multiple Boot

Strict adherence to the copyright law is easy for most teachers until it comes to the multiple boot problem. Most interpreters of the law insist that removing a disk from one computer and running that program simultaneously on another is a violation of the law. Most teachers feel that this is unduly restrictive and compare the practice to passing a book around. The fair use guidelines for computer software might address this issue and suggest situations where multiple booting is permissible.

Until There Are Fair Use Guidelines

Since a publisher has the right to further narrow the copyright law or to waive portions of it, educators should request permission to make copies of the product in situations where fair use seems reasonable. Encourage publishers to grant those requests by purchasing multiple copies of their products when fair use copying would not be justified.

I have reviewed the policies (in most cases the statements which come with the software) of a sampling of software packages which are used in education:

Name: Think Tank
Publisher: Living Video Text
Restrictions: Product may not be rented, loaned or otherwise transferred without permission. Product belongs to the publisher.
Waivers: Expressly permits more than one backup for personal use.
Copy Protected: Yes

Name: Apple Logo
Publisher: Apple Computer
Restrictions: None
Waivers: Disallows copying "except for personal convenience."
Copy protected: Yes

Name: pfs:file
Publisher: Software Publishing Corporation
Restrictions: None
Waivers: None
Copy protected: Yes

Name: Visicalc
Publisher: Visicorp
Restrictions: May not transfer unless new owner signs licensing agreement.
Waivers: None
Copy protected: Yes

Name: M-ss-ng L-nks
Publisher: Sunburst
Restrictions: None
Waivers: Expressly allows multiple boots.
Ownership: Purchaser
Copy protected: Yes

WHAT IS SOFTWARE PIRACY?

Nancy E. Willard

> "But we're doing it for the kids. Everyone else is does it. Nobody ever gets caught. And besides, the software is just too overpriced, the publishers are uncooperative and don't understand schools, all they are concerned about is their own money. The law is too complicated to understand, so we are just ignoring it. This education, so copying is fair use. Look at all the money we are saving the taxpayers."

Software piracy is, almost certainly, occurring in your school district. In spite of all of the rationalizations and justifications for it, and in spite of the fact that there may be some unresolved legal questions, it is in your best interest to institute tightly controlled policy and procedures that will prevent software piracy.

Software publishers are beginning to realize that software piracy is not going to stop until they do something about it. School districts are not immune from law suits. A few well-publicized suits would be an effective variable negative reinforcement technique to control the continuing unlawful practices. The damages that a publisher could recover against a school district and school personnel include actual damages (lost profits), statutory damages (up to $50,000) and costs, including attorneys fees. If you and your school district are not actively striving to prevent software piracy, you may well end up the example case, the test case.

The quality of educational software and the quality of back up and support are directly related to the financial stability of the software publisher. Every act of piracy is theft of the rightful return of investment of the software publisher. Without the return of investment, there is no money for continuing support, no money for future development.

Software piracy is just plain wrong. It is denying to another that which they rightfully deserve. Most educators, once they realize the legal requirements, strive to comply with them. Education regarding this issue is a necessity.

What Is Software Piracy?

Software piracy is the use of a copy of a software program that is not permitted under the license agreement under which you obtained the software and/or the copyright laws. Obviously, schools are not the only setting in which piracy is taking place. Piracy is rampant, in business, at home, in computer user's groups.

Some of the reasons that piracy is so rampant are: It is easy to accomplish, unless the disk is copy protected, in which case it is an exciting challange; The copy is exactly the same as the original, unlike a "Xeroxed" copy of a book; Many programs are expensive, so there is a great financial incentive; and, There are virtually no negative consequences.

Why Is Obtaining Software So Complex?

The process of obtaining a copy of a software program appears to be unduly complex. If you want a book, you purchase a book, not so with software. The reasons for the complexity are the unresolved legal issues pertaining to the use of software subsequent to transfer and the perceived lack of sufficient protection granted under the copyright laws.

Licensing

At this time, virtually all copies of a software program are transferred by license. You have not purchased the program, you have licensed a copy of it. The license agreement that you either signed or that you impliedly agreed to when it came with the copy of the program controls your use of the program. You are not an owner of the copy of the program, therefore the provisions of the copyright law that pertain to owners of copies of programs, 17 USC 117, probably do not apply to you. If there is a conflict between the rights you are given under the copyright law and those granted under the license, the license agreement, if found to be valid, will control.

However, there are questions as to the validity of the so-called "shrink-wrap" licenses in circumstances where the recipient has had no direct contact with the publisher. "Shrink-wrap" licenses are those which are on the outside of a program package that you impliedly assent to by opening the package. The issue of validity has not been resolved by the courts. The prudent advice is to assume the licenses are valid until you have an knowledgable attorney give you an opinion, in writing, that the license is not valid and you do not have to follow it. If you have had direct communications with the software publisher, the license is probably valid. If you have negotiated special terms or have signed a license, it almost certainly is valid.

Copies of programs are licensed rather than sold because of the software publisher's desire to retain more control on your use of the copy than is currently possible under copyright law. The license agreement may restrict your use in certain areas, but it may also grant you permission to do that which would not be possible under the copyright laws. For example, multiple use is not permitted under the copyright laws but the right to do so may be granted by license.

The typical terms found in a license agreement are:

(1) No copying of the program or the documentation.
(2) Provisions for archival or back up copies and for replacement of defective or damaged disks.
(3) No rental of the program. Sometimes not explicit but stated in terms of what transfers are permissible.
(4) Use on a single computer only. Use on subsequent computer permissible but not simultaneous use.
(5) Terms under which license may be transferred.
(6) No networking or terms for licensed networking.
(7) Warranty disclaimers.

If you have a question as to whether a certain use of a software program is permissable, the first place to look is your license agreement for the particular program. If the answer is not there or if you do not understand it, ask an attorney who is knowledgable about computer software law.

A license agreement is not written in stone. If your prospective use would not be possible under the license, it may be possible to negotiate for special provisions. If a license has terms which make use of the program unworkable in a school setting and if an software publisher refuses to negotiate, it may be advisable not to deal with this publisher. You may rightfully question the level of quality of software from a publisher who does not understand the needs of schools. On the other hand, listen carefully to the publisher's legitimate concerns and recognize that some of the limitations are vitally necessary to prevent piracy.

Copyright

The Copyright Act is based on the United States Constitution which provides that Congress shall have the power "to promote the progress of science and useful arts, by securing for limited time to authors and inventors the exclusive right to their respective writings and discoveries." Article I, Section 8.

The copyright owner is possessed of five exclusive rights in a copyrighted work, which are the rights to make copies of the work, prepare derivative works (adaptations), distribute copies of the work to the public, perform the work publicly and display the work publicly. 17 USC 106. It is important to distinguish between a copyright owner and an owner of a copy of a copyrighted work. With limited exceptions, these rights belong only to the copyright owner.

To the owner of a copy of a computer program, the Copyright Act grants an additional, limited right, which is the right to make a copy or adaptation of a program if, and only if, that copy or adaptation is an essential step in the utilization of the program or that copy is for archival purposes. 17 USC 117.

Under the "first sale doctrine" of copyright law, the copyright owner has the right to control the first public distribution of the work, but after the owner has exercised this right he or she cannot control the further disposition that particular copy of the work. The owner of the copy has the right to resell or otherwise distribute the work, but may not reproduce it.

The "first sale doctrine" is one of the major concerns of the software industry because it would allow for the rental or loaning of copies of computer programs. Loaning a program almost invariably results in the unlawfully copying of the program. This is one of the major reasons that programs are transferred by license rather than sale. A license will usually restrict your right to loan.

Educators frequently rely on the the fair use provisions of the Copyright Act as a defense to a claim of infringment. 17 USC 107. The fair use defense is only applicable is situations where an educator has copied an insignificant portion of a work and where the copying does not have a significant effect of the market for the original work. The only use of a computer program that would appear to fall under the fair use defense would be copying an brief excerpt of a program for use in demonstrating a certain programming technique, or the difference in source code and object code, or the like.

Another aspect of copyright law that educators and school districts should be aware of is that of contributory infringment. A contributory infringer is "one, who with knowledge of the infringing activity, induces, causes or materially contributes to the infringing conduct of another * * *." Gershwin Publishing Corp. v. Columbia Artists Management, Inc., 443 F2d 1159, 1162 (2d Cir 1971). Furnishing a copyrighted work to another knowing of the other party's intended illegitimate use would meet this definition. If any school employee is furnishing a copy of a program to a third party with knowledge that that party will copy the program, the school district and the employee could be held liable for contributory infringment.

One element of copyright law, not pertaining to the issue of piracy, may warrant your consideration. If you have teachers who are developing programs, it is important that you establish, in writing, who has ownership rights to the work. The "work for hire" and other ownership standards of the Copyright Act are complex and the situations require careful analysis. You can avoid problems by consulting an attorney who is knowledgable in the area of copyright law.

What May I Do? What May I Not Do?

Archival copies (also known as back up copies)

Under copyright law the owner of a copy has the right to make an archival copy, provided that this copy is not used in addition to the original and provided that when the original program is transferred to another party, the archival copy is transferred or destroyed. Almost all publishers recognize the need for archival copies and provide for this need in various ways, generally with limitations similar to those under the copyright law.

Multiple loading

Multiple loading would be an infringment under copyright law. The copyright owner has the ability to grant you a license for multiple loading, but the typical license does not grant you this right. If your needs require simultaneous use of a program, negotiate for this right with the publisher.

Sequential use

Under copyright law and under most license agreements sequential use is permissible.

Networks

You do not have the right to use a copy of a program in a network situation unless the program was specifically designed for such use. To determine whether the program has been designed for such use, check your license agreement. If there is no provision in your license agreement for networking, negotiate with the publisher for this right.

Loaning Software

Under the "first sale doctrine" in copyright law, an owner of a copy of software may loan that copy. Most license agreements prohibit this type of transfer. Of most concern in this area is whether you have reason to believe that the party to whom you are laoning the software will make a copy of it. If so, you can be held liable as a contributory infringer.

Public Domain Software

Some software is considered to be in the public domain because it was developed with public funds and/or because the developers have contributed their software for free public use. Public domain software can be freely copied and transferred, but not for a profit. Public domain software is perfect software for use in a lending situation.

What Can Be Done To Help Resolve The Piracy Problem?

There is an obvious need for educators and publishers to actively communicate their concerns and needs to each other and to work together to resolve problems. Educators and publishers each must also each take the initiative to establish standards and policies that will contribute to preventing piracy.

Software Publishers

Software publishers must recognize and provide for educators' needs, including licensing provisions allowing for multiple use and/or networking at reasonable prices and the opportunity to preview programs. Publishers need to realize that excessive prices or unreasonable terms are factors which encourage piracy.

Publishers also need to be encouraged to pursue their legal remedies against those school districts which are blatantly infringing their copyrights and violating their license agreements. This would reduce piracy, which should result in the reduction of prices and in the improvement of the quality of software.

School Districts

School districts need to develop policies and guidelines for the use of software that meet the legal requirements, are clearly understandable, are widely publicized and are strictly enforced, with meaningful negative consequences.

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Procedures need to be established to insure at least the following:

(1) Any software which is ordered for preview is strictly controlled and not unlawfully copied.
(2) A program is used only in accordance with the terms of its specific license.
(3) Software is not allowed to leave a school district building unless the school district owns that copy of the software (not a licensee) or the software is in the public domain.
(4) Annual inventories are made.
(5) Warning notices are posted which clearly indicate the consequences of unlawful copying or use.
(6) Required in-service training in the area of copyright law and the proper use of copyrighted works.
(7) Course work for students pertaining to the issue and the consequences of software piracy

Carefully planned, centralized purchasing could result in more effective use of limited funds and in the purchase of higher quality software, thus reducing the financial incentive for piracy. Purchasing agents would be more knowledgable of the licensing procedures and could negotiate more favorable licensing arrangements for the district. Multiple licenses could be obtained for the district as a whole, instead of individual licenses for each school. The purchasing agents would gain more familiarity with the programs which would result in the acquisition of higher quality software.

School districts must realize that if they are not actively preventing software piracy, they are most certainly part of the problem. Educators should also realize that they are in a unique position to assist society in coming to an understanding of the value to be gained in the protection of an individual's property rights in the technological age.

Suggestions for Further Reading

Brooks, Daniel T., "As New Technology Booms, What is 'Fair Use' of Educational Software", NASSP Bulletin, 68, 469 (Feb 1984) pp. 66-74.

Finkel, LeRoy, "Software Copyright Interpretation", The Computing Teacher, (March 1985) p. 10.

Helm, Virginia, Software Quality and Copyright: Issues in Computer-Assisted Instruction. Washington D.C.: Association for Educational Communications and Technology, 1984. 155 pages.

COMMUNICATIONS STRATEGIES FOR THE COMPUTER COORDINATOR

Lloyd R. Meskimen

The computer coordinator whether in a building, district or service district is faced with communications problems. Communication is a two way street - input and output. The computer coordinator routinely communicates with:

1. School administration.
2. The public.
3. Parents.
4. Computer Professionals.
5. Academia.
6. Students.
7. District Support Personnel.
8. Colleagues.

Each of these groups present some input and each require some output. I have presented more ideas than you can use. Select the ones that appeal to you and save the rest for later. I hope that you always have more resources than you need.

The purpose of this paper and the accompanying presentation is to present many strategies to make this interchange most efficient and supportive for both sides of the input/output street.

1.School Administration.

Before we go much further, let me say that school administrators have found themselves, along with the rest of the educational community, caught by surprise by computers. They have little time to become familiar with computers. I am always surprised by the creative ways they manage to provide computer resources for their faculties and students. My hat is off to them.

Here are some ways to improve communications with administrators.

Output: (to)

a. The return memo. After any meeting with any administrator at any time, send them a return memo confirming what was said. "This is to confirm that..." It allows them to tell you that wasn't what was said quickly without you finding out much later. It helps them keep a record of what happened, too.

b. Talk to her/him face to face as much as possible. Better opportunities to read body language, show support and, if you're not in that school, to visit.

c. Read the personality. Is this person a Driver, Socializer, Talker, or Thinker. Respond appropriately. Some want a 'How do you do?', and others want a plan ready to go.

d. Remember that they're the boss. Your job is to help support that position. Give helpful suggestions, not underground revolution. Keep the administrator posted.

e. There are administrators in the administration building. Keep these folks in mind when training comes around. Drop by and share ideas and see how there entry into the computer age is coming.

Input: (from)

a. Develop a file system to keep track of the administrative memos you get. A database can keep track of these files.

b. Learn to spell their names correctly. A database with names, phone numbers, mileage to school etc. will help.

c. Keep a phone log. (This can be a database) Keep track of who called, when, what was the jist of the conversation, a keyword (e.g. software, hardware, training, curriculum etc.) and what agency. I have recently added a column to denote if there is anything pending and what it is.

d. Go to meetings. Planning meetings, board meetings, budget meetings, curriculum meetings. The more you go to the more information you get. (I know you don't have time, but it's still true.)

e. Collect minutes. This is second best to actually going. It is often a great surprise what money gets spent, what other schools are doing and other computer projects going on with or without your input!

2. The Public.

The Public is quite generous if it knows what's going on. It is also quite proud of it's schools if it is informed.

Output: (to)

a. Join local computer user groups. Find as many as you have different types of machines. If this is too many, maybe you will soon see the value of standardizing on one or two machines.

b. Speak to local groups. Many calls come in from businessmen's clubs, day care centers, summer camps, women's groups, churches etc. We're all trying to figure this thing out.

c. Watch and feed the school public information department. They need and want current info on what's happenig.

d. Attend local or statewide office products shows. It is surprising to see what business is buying and using.

Input: (from)

a. Read any computer journals you can get. Keep a file of topics which interest you. Always read the table of contents first. Pick 3 or 4 regulars that provide you with the information you need.

b. Watch public television. Watch the news. Read the paper.

c. Identify and keep in touch with two or three people in the businessworld and ask questions.

d. Get on a computer committee with business people. Vocational assessment/advisory committees, joint venture committees, budget committees, etc.

3. Parents.

Parents differ from the public in that they have a greater and more immediate investment in what you're doing. As a consequence they are often more ready to help and to criticize.

Output: (to)

a. Include any parent who wishes on your monthly computer newsletter.

b. Make a file of volunteers. Note interests, times available, training needed, etc. Parents raised $26,000 in Bend. Parents carried on the computer program at one elementary school in another city until that staff could pick it up. Parents need to know too.

c. Help set up a community schools class for parents and other members of the community.

Input: (from)

a. Go to local school advisory meetings. Share information and seek advise. Be cautious of the local hacker/pirate. Their help often comes loaded with strings.

b. Talk to parents at back to school night, conferences, career days etc. Let them know what your doing (output) and hear what they are doing (input).

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4. Computer Professionals.

Talking to other computer professionals on a regular basis is like attending a computer conference without having to go to any of the sessions.

Output: (to)

a. Put out a monthly newsletter. You have no idea how valuable the information you carry around is to others until you jot it down and send it around to those who want to know. KISS - Keep It Simple Stupid! Use lists wherever possible, leave lots of space, use graphics, list questions, frame statements, etc. Don't worry if you don't have time. Some of the best newsletters are put out on the spur of the moment. By the way, INCLUDE NEWS!

b. Write something for your favorite computer journal. It may be a simple idea you have for presenting new software to kids. We're all waiting for it.

Input: (from)

a. Form a computer user's group of your own. Meet monthly, but don't plan more than half of the meeting. The other half is for just talking to each other.

b. Go to computer conferences, or any other conference, they're all talking about computers.

c. Go back to school. Inservice courses are great, but many are band-aid. You are going to get the best information at school.

5. Academia.

Although we didn't have time to face the onrush of the computer revolution by going back to school, and although there weren't any courses there anyway, THAT TIME IS PAST. Now we need to get in touch with the colleges and universities.

Output: (to)

a. Teach a class. All kinds of adults are looking for someone who can share information about computers with them. You can do it in the evenings, on weekends, at home, at camp, or on a cruise.

b. Do research and publish it. Just because your out of school now doesn't mean you should quit learning. Seek help from others to do this. Do it as part of a graduate program or grant. Go to a conference and present it.

c. Set up a support group. Meet three times a year or so and include some brain power. Look at what your doing and see if anything needs modifying. You'll have a lot of input for them too!

Input: (from)

a. Take a class. Get another degree. Go to school this summer. I know I mentioned this before, but I think its important.

b. Talk to the colleges and universities. They are working on it. and there are other places to talk to also, like the NWREL.

c. Read research journals. Do online computer searches for each project you undertake. The results will surprise you.

d. Consider CompuServe. I have found the EPIE SIG full of folks with strong academic background willing to give me their thoughts on what I am doing. (See attached)

6. Students.

Students are THE source of help for a busy computer coordinator. It is not far from the truth that at least in this country, it was the students who brought us up to the stage we are today.

Output: (to)

a. Watch out! Computer students are curious, independent, opinionated, and self motivated. They can try the best of us. Set reasonable limits and stick to them.

b. Share the curriculum plans with them. Present study guides, grades, tests, grading method and any other information.

c. When you don't know, ask. Maybe a student can help you out.

Input: (from)

a. Get some help. Students can print out stuff at the end of the day, check discs, straighten up, tutor, help you with a programming problem etc.

b. Allow students to sit on advisory councils.

c. Talk to students and read their work. Students as a whole are extremely helpful in their remarks in a new computer class, program, or presentation.

7. District Support Personnel.

There are people all over your district ready and able to help you. Learn to delegate, and learn to schedule.

Output: (to)

a. Get a district directory. Use a highlighter to mark the phone number of those you know can help.

- maintainance for fixing, wiring, cleaning, storing, painting.
- purchasing for replacing, getting best price, dealing with vendors.
- printing for running off workshop flyers.
- secretaries, for everything.
- curriculum, for texts, help in selecting software, planning.
- data processsing, for help with hardware selection.
- evlaution, for evaluating useful programs.
- media, for selection and cataloguing of software.

b. Call district support personnel. Visit with them in person. REMEMBER they are busy, so let them know ahead of time. ASK how they can help instead of TELLING them what to do. You will find a wealth of resources.

Input: (from)

a. Send copies of your newsletters, building plans, workshop schedules etc. to them. Ask for real feedback.

b. Invite them to your activity.

8. Colleagues.

Here is the group you'll get the most support from and the most resistance. Take it easy with them. Each step is a foothold.

Output: (to)

a. Be insidious. A little help on a regular basis is often better than alot of help all at once.

b. Use the smoldering inservice. Talk to one teacher at a time. When you have something to offer, spend time sharing it with someone. Soon you will have help and support. Soon the embers will fan into a flame.

c. Use PRINT SHOP... it never fails (unless you have the wrong printer.)

INPUT: (from)

a. Listen to their needs. Do something to help. Often a short help session will get them moving.

b. TELL them when you don't know. Often their expectations are much higher than your experience. Let them know where to continue the search and how.

GENERAL REMARKS:

SPECIAL NOTES: these are general notes to be included in the end and become the focus of the presentation.

1. Keppner Trego, a bubble sort for decision making.

2. Newsletter - lists, space, newsroom, who contributes,
- see sample of the Portland D.U.M.P.

3. Phone calls - a graph

4. Effectiveness rating of your day.

a. control	1 - planned
	2 - unplanned
b. useage	3 - urgent
	4 - important
	5 - unimportant
	6 - routine
	7 - imposed
c. satisfaction	8 - satisfied
	9 - unsatisfied

5. The Book. Several new books are available to manage your time and your work. I use the Day Runner.

PRUCHASING PROCESS

Dale Reed

Public purchasing is that area of government which seeks to provide equipment, materials, supplies, and services at economical prices by seeking competition and evaluating the most advantageous proposals and taking into account the needs and best interests of the government. A basic distinction between public purchasing and private purchasing is that public monies are being spent, the activity is public business, and records and information related to purchases are open to public inspection. This openness protects against favoritism and fraud because public officials must be prepared to account for and defend their actions against public criticism. The public purchasing organization must have safeguards to cope with social and political influences while, at the same time, providing public purchasing officials with freedom to use professional judgement and personal initiative to function effectively in the public interest.

Complexity and variety are inherent in the various steps in the acquisition and supply processes. There are, however, certain sequential steps which are fundamental to all procurement actions. These sequential steps are identified as follows.

Needs Determination: the initial step in the procurement process. A determination of a need for products and services is developed as a result of an agency's analysis of its needs to achieve its mission.

Needs Satisfaction Analysis: the process by which a decision is made either to use existing stock or to contract for the product, system or service.

Acquisition Strategy Develompent: the step by which a comprehensive plan is developed to fill an identified need by contract.

Solicitation Preparation: the process of structuring a formal statement of the need for products or services and the associated terms and conditions under which the agency seeks formal offers from the private sector to fill that need.

Evaluation and Selection: the part of the acquisition process wherein offers from the private sector are weighed by the agency against its stated needs, terms, conditions, and evaluation standards and a supplier is selected.

Contract Execution: the effort whereby the agency and the supplier come to a meeting of the minds.

Contract Performance: the oversight and surveillance by the agency of a contractor to assure that all obligations are carried out.

Delivery of Product and Services: the act of providing to the agency the product, system or service contracted for and the agency's acceptance of that product, system or service.

Supply Management: all states of material management, including cataloging, requisitioning and issuing, inventory management, storage, distribution, transportation and utilization.

Disposal: the act of getting rid of excess, surplus, scrap or salvage property, generally by means of transfer, donation, sale, abandonment or destruction.

Specifications make real competition possible. If the needs of the government are expressed in clear and unmistakable language, the bidder can submit a more intelligent price quotation, the purchaser can make a more accurate comparison of the bids received from various sources to determine which is best, and the inspector can determine whether or not the government is receiving what it ordered.

The preparation of specifications is a technical task requiring the combined services at times of the engineer, the chemist, the inspector, the buyer and the user. Consultation with the manufacurers is frequently helpful, especially in determining whether the proposed specification is practicable from the producer's standpoint. The specification should describe articles which are commercial standards, and thus avoid designating articles which would have to be specially made.

The degree to which specifications are open or unrestrictive directly affects the end extent of competition obtained. In addition, specifications provide a control to assure that the proper level of quality is pruchased. Specifications are public records; they serve to keep the purchasing process open by allowing the public to see exactly what is being pruchased. Specifications are used during the evaluation process to determine whether or not bids are responsive. Any bid that does not substantially meet the requirements set out in the specifications cannot be considered for the award. Unsuccessful bidders and internal management can use the specifications in a post-award review to assure that a proper award has been made.

Specifications take many forms, some of which are better than others. "Brand name" specifications cite a brand name, a model number, or some other designation that identifies a specific product of a manufacturer as an example of the quality level desired (61:11.4). Items equaling or surpassing this quality level are understood to be acceptable. Although brand name specifications are not considered good specifications, they have a legitimate, though limited, place in public purchasing and are probably used to some extent by all state and local governments. The specifications should always be accompanied by a phrase such as "or Equal" to indicate that items equivalent in quality to the specified brand names will be acceptable. Brand name specifications can cause problems in three major ways. They can lessen objectivity in the process of evaluation and award; they may reduce equality of opportunity among bidders; and they often discourage competition.

A qualified products list is a form of specification in which various brands are examined, approved, and placed on a list. When an Invitation For Bid (IFB) is issued, the bidding is limited to vendors whose products are on the list. The purpose of this type of specification is to determine in advance those products which comply with specifications or are otherwise acceptable. The evaluation of bids is greatly simplified, and the price and the performance capability of the bidder become the determants. One of the main reasons that qualified products lists are established is to avoid the problems that occur when the low bidder offers a product whose conformance to specifications is unknown and difficult to ascertain. An advantage of this approach is that it reduces the amount of testing in the long run because simultaneous tests can often be run on several brands. Once a product is accepted for the list, it does not need further tesing until either the specification or the product changes.

Design specifications are the most traditional type of specification and set the requirements for the item to be purchased by detailing the characteristics that the item must possess. "Design" in this connotation means that the specification is so detailed that it describes how the product is to be manufactured. It has been used historically in public contracting for buildings, highways, and other public works, and its use is essential where a structure or product is to be made to meet the purchaser's design.

The popularity of performance specifications has developed steadily in recent years. As the name indicates, these specification set out the performance requirements a product is to meet. Using this concept, the end result is the priority consideration and, in contrast to the design approach, the manufacturer or producer is given great latitude in how he/she can accomplish it. This encourages ingenuity, innovation, and cost reduction. Performance requirements describe the capabilities that are necessary to satisfy the intended use for the article. Tests or criteria are developed to measure a product's ability to perform and to last as required. Performance specification generally provides the best approach to specification writing.

No one type of specification is best for all types of products. Thus, in an Invitation For Bid (IFB) covering hundreds of automotive parts, the use of brand names "or Equal" is satisfactory. For the purchase of lead pencils, samples and trial may serve best; for magnetic computer tape, a qualified products list; for an X-ray machine, a modified design specification; for gasoline, a performance specification; and for an air compressor, a combination design-performance specification. Specifications can include both design and performance features. A design specification can and frequently does contain performance requirement, and vice versa. Characteristics of both are used as prerequisites and as limiting factors in developing qualified products lists.

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EXAMINING THE PREVIEW AND PURCHASING POLICIES OF EDUCATIONAL SOFTWARE PRODUCERS: WHAT TO EXPECT AND HOW YOU CAN TAKE ADVANTAGE

Dave Weaver

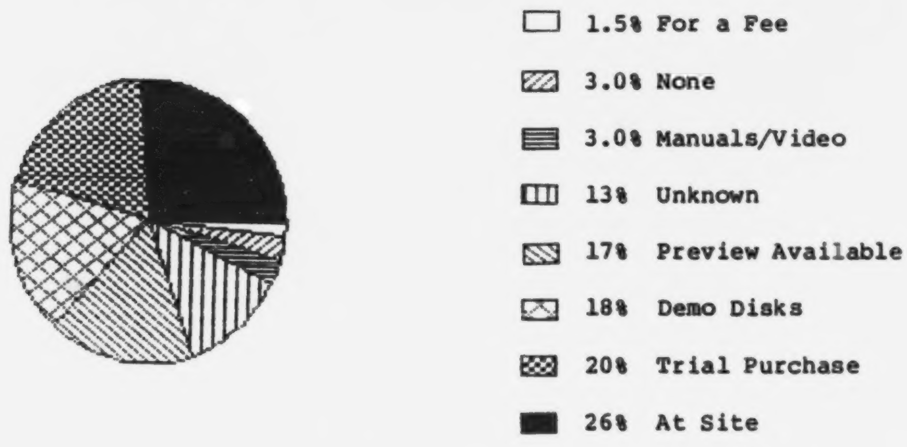
There are more than 750 producers of educational software furiously competing to market a total of approximately 9,000 to 10,000 software products to schools. Those on the receiving end of this onslaught are frequently overwhelmed.

Beside the sheer numbers involved, the situation is complicated when one takes into account that each producer has developed their own policies regarding preview, discounts and backups. This paper reports the results of a tabulation of these policies for 492 educational software producers. The data reveal that these policies differ widely among the producers. As monumental and hopeless as the situation may seem, the data does provide some useful insight as to what schools can do to improve their negotiating position with the producers.

Examining the preview policies

There are a wide variety of policies governing if and how producers will make previews available to potential buyers. These policies can be grouped into several general categories which are outlined below.

SOFTWARE PRODUCER POLICIES
PREVIEWS



- Thirteen percent of the 492 producers either did not have a policy or did not make it known.

- Twenty-six percent of the producers indicated that previews were only available by visiting a site which owned a copy of the package. These sites are generally local computer stores and retail sales outlets, preview centers established at various educational service agencies and district offices, demonstrations at conferences, or at some other school in the region who has purchased the package. A list of regional preview centers appeared in the January 1984 issue of Electronic Learning magazine. Information concerning other users of the package must be obtained from the producer if it is available.

- Twenty-three percent of the producers allow one of two forms of trial purchase period. The first type is more of a satisfaction guarantee. The package must first be purchased. It may then be returned in good condition for a full refund within a designated time period, usually 30 days. The other type typically requires a purchase order prior to shipment of the package. If the previewer elects to keep the package, the purchase order is processed. If not, the previewer has a designated period to return the package and cancel the purchase order. In either case, the previewer must commit funds either for purchase or for a temporary time during the preview.

- Eighteen percent of the producers provide a demo disk for previewing purposes. Of that, half require the previewer to purchase the demo disk at a greatly reduced price. Demo disks are generally some representative sample of the complete package. However, they have been known to contain more or less a slide show of the various screens encountered by the user. Most are subsets of the complete package.

- Seventeen percent provide a preview copy of the package upon request. Most of these producers have some restrictions or means of screening the requests. Frequently, the request must be in writing and may include other stipulations such as school letterhead or district level authorizing signature.

- Three percent of the producers will not make preview copies available. Interested persons must purchase the package to gain firsthand experience.

- One-and-one-half percent charge a preview fee, generally in the form of a rental fee.

- The remaining producers (approximately three percent) use a variety of other means of providing preview information. These methods include videotapes, manuals sold separately, and workshops.

What Schools Can Do

Unfortunately, few of the software preview policies outlined above truly meet the needs of educators. As a result of this work, it became evident that there are a few things that educators can do to improve the situation.

First, develop a district level process which centralizes the requests for preview copies of software. Producers are much less likely to respond to a request for preview software which originates from an individual teacher. This centralization will make the progress more convenient for the teacher and eliminate the possibility of duplicate requests or requests for packages already owned by another school in the district.

Second, develop some well-organized district-wide policies regarding software previewing and copyright protection. The previewing policy should take a strong no preview, no purchase position. Doing so will minimize blind purchasing and reduce waste. The same policy can also be communicated to the producers, putting pressure on them to make preview copies more readily available.

At the same time, a strong copyright policy must also be implemented and enforced. Without a strong copyright policy, a preview policy is likely to have little effect. An excellent model for developing such a policy is the ICCE Policy Statement on Networking, Multiple Machine Software, published in the September 1983 issue of the Computing Teacher. Together the two policies demonstrate a high level of organization which will communicate a strong, fair, and open position the producers are very likely to respect.

Third, requests to producers for preview copies of software should be in writing, on school letterhead, and signed by someone in a decision-making capacity. The letter should include a copy of the district copyright and preview policies, and any other related information about the school system. The letters should originate from the centralized preview requesting agent.

Fourth, the requesters should demonstrate that they represent an organization which is a potential buyer. They should establish a budget for the purchase of educational software. One way to communicate this is to include a purchase order along with the request. However, it must be made very clear that the purchase order is for preview and not for purchase of the software. One possible way of arranging the budget to facilitate this process is to create a district-level account exclusively for previewing software. Purchase orders can be written against this account with the stipulation that replacement money is available in the building-level software purchase account in the event the previewer elects to keep the package. In this way money is always available for requesting preview software. The funds can be carried over to the next year or expended for other items at year's end. A negative aspect of this practice is the overhead cost involved in the processing of the purchase orders. Current trends indicate that an increasing percentage of producers are adopting policies which require a purchase order for software preview. If this trend continues, the overhead costs may be unavoidable.

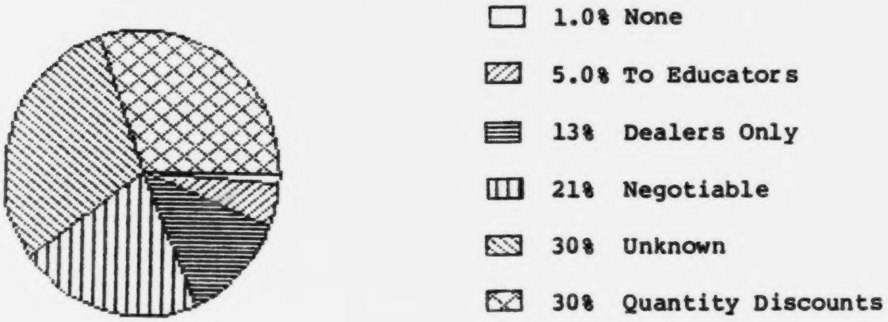
Finally, there is the possibility for a school district or county agency to establish its own preview center. However, producers are becoming more selective about which preview centers they will support with donations of software. Newly established preview centers will need to guarantee service to a substantial number of schools in the region in order to obtain donations. Centers serving a limited number of schools will likely be required to purchase a greater portion of their collection.

Implementation of the suggestions above will greatly improve any school's ability to borrow copies of educational software for preview purposes.

Examining the Discount Policies

Fiscally, schools are always interested in ways to obtain the best possible price once the purchase decision has been made. Just as preview policies differ among producers, so do discount policies.

SOFTWARE PRODUCER POLICIES
DISCOUNTS



- Of the 492 producers tabulated, thirty percent either do not have any policy regarding discounts to schools or choose not to make the policy public.
- Thirty percent of the producers have developed a quantity discount schedule.
- Twenty-one percent are willing to negotiate a discount on an individual basis.
- Thirteen percent will only give discounts to dealers and other retail outlets.
- Only five percent offered a flat percentage discount to educators.
- And finally, one percent stated that they do not discount.

What Schools Can Do

In summary, it is clear that at least fifty-six percent of the producers will discount their products to educators. This percentage is likely to be considerably higher because some of the thirty percent who did not make the information available will discount. The data also reveal that most discount policies are linked to quantity purchases.

Given this information, the issue then becomes a matter of taking advantage of the price breaks which already exist:

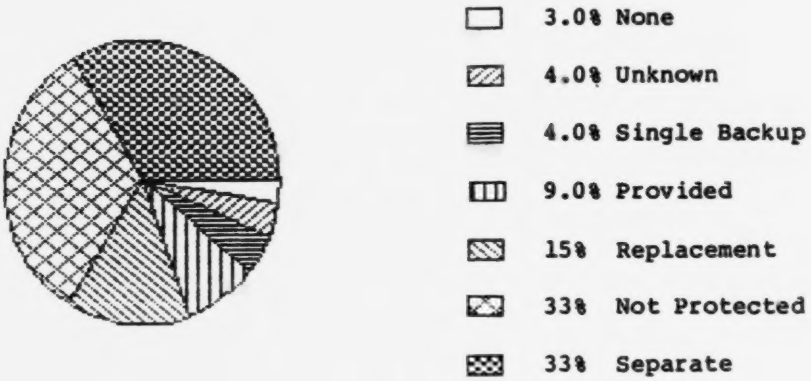
First, design and implement a well-organized district-wide software selection process. Careful selections encourage a wider use of fewer different packages.

Second, centralize the purchasing at the district level. Small orders can be combined into a larger order. The centralized purchasing agent can use the bidding process or competitive pricing between discount houses to obtain the best prices.

Examining Backup Policies

The real surprise in the research came from an examination of the various policies producers have developed for providing backups of their products.

SOFTWARE PRODUCER POLICIES
BACKUP



- Only about four percent of the producers either had no policy or did not make the information public.
- Thirty-three percent of the producers required the purchaser to acquire the backup separately. This could be done either by purchasing the backup at time of purchase, or after the receipt of the owner's registration card.
- A suprising thirty-three percent of the producers do not protect their product, thus allowing the buyer to make their own backup.
- Fifteen percent of the producers provide a replacement service as a backup policy. Of that, less than half charge a fee for the replacement diskettes.
- Only slightly under nine percent of the producers automatically provide a backup disk as part of the regular package.

- Four percent provide an installation mechanism which allows a single backup to be made.

- Three percent of the producers make no provisions for backups.

What Schools Can Do

It is clear that one cannot assume that a backup disk will be provided when purchasing a product. It is also clear that according to the copyright laws, purchaser is entitled to a backup of the disk for archival purposes. What is not very clear is how the purchaser is expected to obtain the backup. Since copy protection schemes are not as widely used as one might expect, many producers expect the user to make their own. The problem comes about when the disk is copy protected and no backup is provided. The purchaser is faced with the choice of using a bit copy program to obtain the backup or otaining the backup from the producer. The copyright laws are not clear whether or not it is legal to copy a protected disk if a backup is available from the producer. This ambiguity is not likely to be resolved in the near future.

In the meantime, to avoid possible copyright violation or the added duty of obtaining the backup at a later date (which is often forgotten), schools should include the backup disk at time of purchase whenever possible.

Conclusion

From the point of view of the educator, it seems logical that the producers would want to standardize the preview, discount and backup policies among themselves. In reality, nothing could be further from the truth. In conversations with software producers where MicroSIFT has addressed these issues, it is apparent that the opposite is the case. A particular preview policy or discount policy is frequently used to get a marketing edge on their competition. For this reason alone, standardization is not likely to occur.

Schools comprise a certain portion of the market and in time have the ability to influence this market in a positive direction. The key word is organization. Schools must develop a well-organized set of policies and procedures in order to avoid falling victim to the onslaught of marketing tactics used by the producers. The implementation of the suggestions outlined above by a significant number of school districts will eventually begin to have a positive effect on the market.

References

The data used for this report were taken from the information provided in The Educational Software Selector (TESS). TESS is a comprehensive educational software directory available from EPIE Institute & Teachers College Press, 1985.

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OTIS IN THE EIGHTIES

INTRODUCTION

This paper proposes that OTIS decentralize many of the functions now handled at its site in Eugene to several regional centers located in strategic areas throughout the state.

The position is supported through:

- a detailed account of the reasons OTIS needs to make changes
- a discussion of the decentralization process
- recommendations for areas to be served by regional centers
- recommendations for distinct levels of service for the centers.

Other factors, such as the ability of certain agencies to serve as regional centers, management's position regarding non-OTIS owned central processing units, and the staffing needs of the centers receive careful and thorough attention.

The paper documents the proposed role of "OTIS Central," reviews the ramifications of the divestiture of the Bell telephone system, and outlines possible responses and the resultant impact on the OTIS telecommunications network.

The report concludes with specific recommendations by OTIS management with regard to:

- actual locations for regional centers
- levels of service to be offered initially at each center
- financial projections
- timelines for implementation.

CHRONOLOGY

The Oregon Total Information System (OTIS) consortium was originally conceived and funded under Title III of the Elementary and Secondary Education Act in 1968 as a service organization which would provide comprehensive and affordable data processing services to local school districts and other education agencies throughout the state.

The original goal for OTIS, as stated in the proposal to the federal government, was "to build and maintain a service organization that would provide Oregon schools with the hardware and technical staff necessary to best meet the computer requirements of schools." The objectives listed in the proposal documents were:

1. To work with each district to secure user satisfaction and the reliability, quality, and cost effectiveness of the services
2. To continue to work towards greater efficiency and cost effectiveness in the use of hardware, software, and personnel
3. To continue development of innovative procedures and software for educational data processing
4. To continue development of instructional service applications to provide direct educational benefits to the students.

Through 15 years of service, these objectives have remained unchanged. The means of fulfilling the objectives have changed, as has the data processing field itself, both becoming more sophisticated and complex.

NEED FOR CHANGE

As OTIS developed and as new users joined, it offered innovation in data processing (DP) and an economy of scale in costs. OTIS was the first to offer an on-line system of data management to schools in Oregon. Soon, OTIS was able to deliver services that met needs and were less expensive than those offered by other available sources. OTIS went on to provide an expanding array of services that anticipated, and then supplied the information districts wanted. Consequently, the user base expanded from the original 55,000 students served in 1968 to the approximately 220,000 students OTIS will serve in 1983-84.

Just as OTIS emerged to meet the needs existing in the late 1960s it must now evolve to meet the differing needs of the 1980s. Districts want and need faster receipt of an increasing amount of varied data. OTIS management believes this thrust will continue and will, in fact, accelerate. We are also convinced that the proliferation of microcomputers in participating districts will continue unabated and that OTIS should assist with the efficient use of those units. It has become increasingly evident that communication link-ups between OTIS and the districts it serves are a factor that must be taken into consideration in terms of format, design, speed, and cost.

While the needs of districts are changing, so are those of OTIS. As more new users join the consortium, the physical plant, data storage capacity, and staff are becoming overburdened. As districts increase their requests for special applications, the capacity to respond appropriately to these diminishes. Further, as the number of services offered districts increases, the realities of forwarding information totally in printed form have to be reexamined. Current technology in hardware and software dictate that the products OTIS creates be delivered in a more timely fashion.

The changing needs of the OTIS organization and its member districts are not unique. Other data processing agencies have faced the same dilemma. One response to the problem has been the concept of distributive processing, in various configurations. Distributive processing involves decentralizing some of the tasks and functions handled at only one site to more than one location. Decentralizing some of the tasks completed at the OTIS site in Eugene could be a very important, necessary, and meaningful step for the consortium, as this position paper will seek to delineate.

A study of decentralization reveals that at least four physical components of a system may be distributed: ".....hardware or processing logic, data, the processing itself, and the control, such as the operating system. A proper definition must also cover the concepts under which distributed components interact."[1]

Proponents of distributed data processing systems say the concept includes:

high system performance, fast response, high throughput
high availability
high reliability
reduced network costs
fail-safe capability
ease of modular, incremental growth and configuration flexibility
resource sharing
automatic load sharing
high adaptability to changes in work load
incremental replacement and/or upgrading of components
  (both hardware and software)
easy expansion in both capacity and function
easy adaptation to new functions
good response to temporary overloads.[2]

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[1] Phillip H. Enslow, "What is a 'Distributed' Data Processing System?", Computer, January 1978.

[2] *Ibid.*

We are not convinced that all of these claims are universally true or totally applicable to the OTIS consortium, however, many of them seem to be.

REGIONS

Decentralized or distributed processing is occurring in many public and private sector institutions nationally. Consequently, if we look for a model, our search need take us no farther than our neighboring state of Washington. The model, an agency with striking similarities to OTIS and Lane ESD, is Education Service District #189. ESD #189's Northwest Regional Data Center component began to decentralize about five years ago. The OTIS management staff has examined that evolution in some detail. In essence, what they have done is move most of the functions that were carried out centrally to nine sites throughout the state. Because of the many parallels between the two agencies, some of their methods could serve as guidelines for OTIS' own decentralization process.

A glance at a map of Oregon shows that there are definite clusters of our user districts. When consideration is given to the realities of geography, certain regions stand out. For example: in the northwest part of our state, districts in Washington, Columbia, Clatsop, Tillamook, and perhaps even Yamhill Counties could logically constitute a region. Another region could operate from the OTIS site in Eugene serving Polk, Lincoln, Douglas, and Lane Counties.

An installation in Coos County could serve the south coast area of Coos and Curry Counties. In central Oregon, a center in Deschutes County could serve Jefferson County and perhaps even Klamath County, and, in the northeast area, a center in Umatilla County could serve users in Hood River, Wasco, Morrow, Union, Baker, and Wallowa Counties.

If a given geographic concentration of users could constitute a practical definition of a region, then a determination must be made of where, within that region, a distributed processing site should be situated. Before choosing a site, a number of factors need to be considered: the number of students served within various parts of a county, costs associated with any site such as physical plant, centrality of location, utilities offered, expertise available, interest evinced, "turf considerations," service capability, the natural antipathy that exists between small districts and large districts, resource allocation of districts to DP, proximity of maintenance people, experience of individuals in data processing, and provision for transportation.

Consideration of these elements leads us to believe that initially OTIS should concentrate on Education Service Districts (ESDs) as host agencies for regional centers. Because ESDs are service entities, they exist to give educational support to local districts in their county(s) and their entire organization is geared to offering that support.

Some ESDs in Oregon already offer DP services and many ESDs have courier capabilities already in place to move a variety of items to their local districts. ESDs are also, by their very nature, "neutral" in offering services to local districts. Thus, ESDs theoretically have no vested interest in favoring one district over another in offering timely delivery, for example. OTIS management is not certain the same neutral environment would exist when priorities had to be determined if a local district were to host a center. A natural tendency could be to meet their own needs before meeting the needs of other local districts. Obviously, whether the institution is a local district or an ESD, there must be some interest within the agency in becoming a distributed processing center.

Not all ESDs, however, are equipped to offer a full array of services. As one illustration, the Deschutes ESD has been so minimally funded it has been able to offer only a limited array of services to its locals. Historically, not many demands for service have been made of that ESD during the last 20 years. Consequently, the local districts have provided support services for themselves, resulting in duplication of effort. In that environment, a logical OTIS regional site might be a local district.

Presently there are a growing number of ESDs which offer OTIS services to all their local districts. Besides Lane ESD, there are Washington ESD, Umatilla ESD, Tillamook ESD, Douglas ESD, and Polk ESD. The success of these operations offers evidence that an ESD located centrally within a region could fulfill many of OTIS' requirements for a regional center.

Unfortunately, when one enters the realm of politics, the reality is that local districts in some counties may not think their particular ESD has the ability to perform the vital functions they require and need in a regional center. In instances where an ESD actually does not meet the criteria deemed necessary by OTIS, or is perceived by the majority of its local districts as being unable to, it would seem a local district would have to be considered and agree to be the host. If circumstances do dictate the regional center be located in a local district, the factors enumerated above need to be present: site convenience and location, utility availability, interest in offering service, transportation offered, nearness of skilled maintenance people, availability of experienced people, and commitment to continuity of service.

Once a site location is determined, the next step would be to convince users to participate in the regional center project. In the judgement of OTIS management, this would not seem to be a problem in most circumstances because a regional system for the delivery of OTIS services could meet the changing needs of districts. Faster turnaround time and savings on communication costs alone will make a significant difference. When the feeling of accessibility because of proximity is added, OTIS management believes the regionals would be attractive to users.

Within each region OTIS must develop some organizational mechanism for obtaining user opinions about new offerings and their satisfaction with services in the region. Fortunately, an answer may be developing for this need. The OTIS Advisory Committee has authorized its own restructuring, based on geographic representation. Since the reorganization plan closely parallels the possible regional sites outlines in this paper, it could be broadened to include regional committees of users. These could meet periodically within their areas to discuss the levels of service wanted and to formally recommend change.

If regional DP centers were authorized by the Advisory Committee, detailed written agreements negotiated by the director of OTIS would have to be drafted which would specify arrangements for physical space, utility support, exact site location, user representation within the region, mechanisms for change, assurances of prompt delivery, and quality of product.

With the passage of time, new user districts will join the consortium. This growth may necessitate the adjustment of territory within a region, or new regions may have to be designated.

LEVELS OF SERVICE

Much like beauty, expected levels of service will be different in the eyes of each beholder. OTIS management believes that levels of service must be monitored and continually updated to justify the viability and usefulness of the regional concept. However, because of factors such as pupil population, geographic proximity, interest and expertise available, and experience with data processing in some depth, expectations within regions will vary. OTIS management also believes once the capability of faster access to output is present, expectations of users will increase. Recent experience supports this belief.

Umatilla ESD is participating in a pilot project with an entry level work station capable of printing a minimum of 150,000 lines of student services output, mostly attendance reporting, for distribution throughout the county. Because of a growing confidence in their ability to operate the equipment and to provide faster turnaround time, the center will soon begin selected business services reporting. OTIS management sees the stage being set for the desire to produce an increasing number of reports previously printed at OTIS and sent to local districts via United Parcel Service (UPS).

Based upon our Umatilla pilot, and a modest effort in cooperation with the Beaverton School District's DP printing facilities, OTIS management believes it can characterize levels of service OTIS should offer.

LEVEL "A"

PRINT CAPABILITY	Selective print only (11 days per month, 3 hours per day) Selective initiate/print Low volume (500,000 lines per month) reports 250 print lines per minute
SERVICES	Financial Selective financial statements Vendor labels and lists Selective budget reports Payroll Simulated payroll run editing Selective employee ledgers and worksheets Personnel State certification error reporting Salary schedules Selective leave reporting Inventory Selective basic reports Attendance Data collection forms Weekly attendance reports Monthly attendance reports 9 weeks attendance reports State quarterly reporting Other Student Services Low volume ad-hoc reports as requested
HARDWARE REQUIREMENTS	400 lines per minute printer 3776 equivalent equipment
PHYSICAL SPACE AND UTILITY HOOKUPS	50 sq feet for hardware Forms storage/supplies space Distribution work space 110 electric power
COMMUNICATION LINES AND EQUIPMENT	2400 baud modems and data transmission lines
STAFF	One full-time machine operator/control/distribution person One half-time field representative

LEVEL "B"

PRINT CAPABILITY	Selective print only (11 days per month 8 hours per day - 3 million lines per month maximum) Selective initiate/print 600 print lines per minute
SERVICES	Financial Entire budget process Financial statement General ledger Payroll Payroll worksheets Employee ledgers Selective payroll distribution/registers Personnel Basic reports Inventory Basic reports Attendance Data collection forms Weekly attendance reports Monthly attendance reports 9 weeks attendance reports State quarterly reporting Enrollment Address labels School/district directories List reports (locker, bus, counselor, rosters, etc.) Health and Immunizations Health worksheets Message to parents Susceptibility lists Primary review summaries Grading Verification rosters Other Student Services Low volume ad-hoc reports as requested
HARDWARE REQUIREMENTS	Series I equivalent equipment (400-800 LPM Printer)

Level "B" Continued

PHYSICAL SPACE AND UTILITY HOOKUPS	100 square feet Forms handling equipment, burster, decollator Distribution work space Forms/supplies storage 110 electric power
COMMUNICATION LINES AND EQUIPMENT	4800 baud modems and data transmission lines
STAFF	Two full-time machine operator/distribution/ control people One full-time field representative

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LEVEL "C"

PRINT CAPABILITY	Systems Software - 22 days per month, 12 hours per day Support local applications (district programs) Initiate print 1100 print lines per minute 9 million lines per month capacity
SERVICES	Financial Majority of report run output except checks and check registers Year-to-date reports
	Payroll Majority of report run output except checks and check registers State and Federal reports as required
	Personnel State reports Majority of salary and leave area reports
	Inventory All reports
	Attendance Data collection reports Weekly attendance reports Monthly attendance reports 9 weeks attendance reports State quarterly reporting

Level "C" continued

SERVICES continued

Enrollment - Basic Reporting Services
- Student locator cards
- Class lists
- Room lists
- Student schedule lists
- Student body rosters
- Locker lists
- Counselor lists
- Bus lists
- Lists of students by period and teacher
- Directories
- Mailing labels
- Student name tag labels
- Data sheets - enrollment verification
- Specialized data bases
  - Handicapped Child Reporting
    - Weekly verification worksheets
    - Year-end reports
  - Health and Immunization reporting
    - Student health worksheets
    - Message to parents
    - Susceptibility list
    - Primary review summary for County Health
    - Immunization statistics
    - Roster of health problems and statistics

Grading
- All system output except grade scan sheets

Transcripts
- All system output

Competencies
- Class list worksheets
- Individual student competencies
- Status reports
- Counselor lists
- Dean's lists
- Statistical reports

Scheduling
- Edit and tally reports
- Conflict matrix
- Master schedules
- Edit listings
- Simulation runs
- Closed runs
- Class lists
- Student schedules
- Teacher schedules
- Room schedules

Level "C" continued

HARDWARE REQUIREMENTS	4300 series unit
PHYSICAL SPACE AND UTILITY HOOKUPS	Square footage will depend upon configuration of hardware Special electrical air conditioning may be required depending upon configuration of hardware
COMMUNICATION LINES AND EQUIPMENT	9600 baud modems and data transmission lines
STAFF	Two full-time operators One full-time operations supervisor One full-time programmer One full-time distribution clerk One full-time field representative

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Since the desires and capabilities of the regions will be varied and will evolve, the levels at which each region would begin would be different.

A major consideration in determining the level at which a given region should operate in any given time-frame will depend upon that region's expectations and the ability to offer service. Another factor to consider is the funding of service levels. At the outset, OTIS should fund Level "A" for all regions. OTIS also ought to be prepared to review, on an annual basis, the level of services it is willing to fund.

OTIS management also recommends continuing the existing Remote Job Entry agreements with the Eugene and Beaverton School Districts.

It is imperative that the quality of service OTIS has always offered be maintained in each of the regional centers. Therefore it is essential that OTIS provide detailed operational standards and definitive staff job descriptions and training to ensure that product quality and customer satisfaction are guaranteed.

CENTRAL PROCESSING UNITS

There is one other level of service that has not yet been examined: the circumstance in which a local district or an ESD either already owns a central processing unit (CPU) or intends to purchase one in the immediate future. At this juncture, OTIS management recommends the consortium's posture should be that any district which owns, or soon will purchase a CPU unit, will do so because they want to own it and will use it for special applications which OTIS does not presently provide. Management believes OTIS should not have any ownership in these CPUs at the present time. However, it believes OTIS should offer those districts the opportunity to purchase support for their CPUs, support which would include programming and/or maintenance on a cost effective fee basis. OTIS should reexamine this posture during its annual review. If a district were to offer to fund additional services which OTIS will not initially offer, OTIS should accept and encourage that type of contribution.

In time, as Level "C" is approached, CPUs may have to be provided to allow regional centers to operate in a manner proposed by OTIS.

OTIS management recommends that districts with general-purpose CPUs have Remote Job Entry capability to enhance delivery and flexibility of standard OTIS services, and that they provide those services to a geographic area that could profit from such localized report ordering and printing. In this set of circumstances, if the agency is willing, the existing CPUs could perform the function of some OTIS-supplied hardware. Obviously, a fair "use" fee would have to be negotiated for this type of arrangement.

The regional center proposition is in line with predictions of the future by renowned computer expert, James Martin. Although the following excerpt from Martin's work deals with private sector corporations, those operations closely resemble the OTIS system.

> We can draw a picture of the computing facilities of a typical future corporation. It will be one or more large computer centers, in many cases about the same number as there are today, but with faster computers. They will perform those computer operations which still benefit from centralization rather than distribution. For example, the large number batch crunching operation, large-in-scale print runs or printing needing special equipment, maintenance of files which are by their nature centralized, running old centralizing applications which have not yet been converted to distributed form, and (particularly important) the maintenance of corporate data bases.
>
> Although there are still large computer centers, there will be a vast proliferation of small computers. Some of the small machines will be promptly linked to your large machines by telecommunications; some will be stand-alone machines; some will be designed for periodic connection to a large computer by a public telephone line or data network. Some of the small machines may transmit to one another independently of the large machines, and there may be networks for this purpose.

> Many of the users of the small machines will relate to data which are stored on large, centralized data bases. The users will employ this data, extract them into their own machines and manipulate them, and often be responsible for updating them.[3]

THE ROLE OF OTIS CENTRAL

The present OTIS facility would serve in two distinctly different roles as the regional concept is implemented. The first would be to serve as a regional center for all of Lane and Douglas counties, the three schools in Lincoln County, and perhaps even Polk County. The level of service to local districts in these counties would remain much as is, that is, the printing and distribution being done at OTIS Central and shipped to local districts via common carrier or Lane ESD courier, or districts picking up their materials.

A second role entails being the central support site for all the regions in the state. The data flow would continue on the same basis as now. However, with the gradual upgrading of the other OTIS centers requiring more semi-autonomous regional capability, OTIS Central would have to provide increased data file accessibility. This may involve operating on a twenty-four hour a day basis. If regionalizing is to be successful, each OTIS user should have access to their data as quickly as possible. An environment must be created in which each user could obtain information as accurately and as easily as they could with their own on-site mainframe computer. The technological movement toward less printed data ought to come from OTIS Central. The efficiency of screen use with faster response time and installation of more interactive operating systems would allow users to seek more visual data. To achieve this goal OTIS must continue, and perhaps accelerate, its acquisition of different and new supported operating software, and of expanded capacity and faster disc drives.

To reach the point at which users will feel as though they had their own on-site mainframe computer, an immediate migration to current operating systems designed to be interactive and user-friendly is imperative. The installation of Multiple Virtual System (MVS), a replacement for or a thorough restructuring of the Generalized Educational Management System (GEMS), the Telecommunication Access Method (TCAM), and other related software, including application programming, must proceed with high prioritization.

These moves would allow for significant change, such as file transfer of data stored at OTIS. It would allow users to extract information to use for their own applications for spreadsheet or micro, and to merge text/data for their specific requirements, or the ability for queries into fiscal files to use in spreadsheet analysis.

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[3] James Martin, Design and Strategy for Distributed Data Processing, Prentice Hall 1981, pp. 23-24.

Although the network would still need to be inaccessible (static) so that files could be reorganized each day, that period of time can be remarkably reduced by the addition of new software, faster disc drives, and added personnel to staff extended hours.

As the evolution of regional centers continues, the OTIS Central site would provide all of the programming which is applicable for the entire system. This would include constant maintenance and revision of existing programs. It would also involve the continuous development of new programs and new services of benefit to the user base. OTIS Central would be involved in uploading and downloading programs, as well as offering contract programming at a reasonable fee structure to those regions needing special applications.

OTIS Central would certainly be the focal point for overall research and development capability. Many new thrusts and strategies in data processing could emanate from OTIS Central and through cooperative links established with agencies such as the Center for Advanced Technology in Education at the University of Oregon, the Valley Education Consortium, the Oregon State Department of Education, and others.

The policy and standards for system-wide products and services would originate from OTIS Central, as would job descriptions and training for people who work throughout the system. Various publications and media for communication, user manuals and guides, and other related material would also issue from OTIS Central.

Training would involve annual preservice and inservice at OTIS for employees of the regional centers. These sessions could include familiarization with equipment, the study of procedures, and the development of knowledge of the capabilities and services OTIS offers. Getting to know OTIS Central personnel on a face-to-face basis, reviewing manuals, and simply discovering the complexities of the total operation would be beneficial to all participants.

Macro system-wide services such as test scoring and development and period-by-period attendance reporting would come from OTIS Central, as would supervision for field representatives operating from the regional centers.

In addition, OTIS Central would continue to provide microcomputer support. Since an increasing number of user districts are acquiring a wide variety of micros and will continue to do so, it is essential for OTIS to fill the existing leadership void. Districts need advice about which type of micro would meet their needs, how the unit of their choice could best be utilized, and ways to use them as terminals.

Training could be offered in computer-assisted education, including data processing training. In essence, OTIS Central would serve as the nerve center for all of the regional centers throughout the state.

OTIS should work toward providing as much evolving autonomy to regions as is practical and meaningful and at the same time keep reenforcing links to OTIS Central by offering superb software, research and development, training, macro-programs, and special applications on a cost beneficial basis. This is the only way to justify the existence of OTIS, and the only way to avoid diminution of membership, which would dilute the cost effectiveness of its services.

STAFFING

The varying levels of service listed earlier in this document bring to attention the variety of people needed to operate the equipment and distribute the material produced in the regional centers. Distance between OTIS Central and these centers would make directing, supervising, and evaluating most of these people on a day-to-day basis difficult. This is particularly true for regions that are relatively long distances from Eugene. Therefore, it is OTIS management's recommendation that operators, and control and distribution people be employees of the district designated as the regional center and be directed, supervised, and evaluated by the managers of that center. The cost should be shared by all user districts in the region on an A.D.M. basis; that is, districts would contribute to salaries upon the basis of how many students they enroll and the number of OTIS services they use. After being employed by the regional center, personnel would receive initial training from appropriate OTIS Central staff. In addition, on a periodic basis, supervisors from OTIS Central would travel to the regions to monitor the performance of these individuals, give them more training if appropriate, and provide updating relative to changes in procedures. They would do this in concert with the managers in the regions. The employment of personnel, on an equitable shared cost basis by all districts served by the regional center, should be part of the commitment by users to the success of the regional concept.

The only exception to this recommendation involves field representatives. Since field representatives by position description are constantly training others, they are the ones who could most directly affect relationships between OTIS Central and the districts in the regions. These people should be hired and trained by OTIS Central which would also pay one-half their salaries. To add to their credibility, field representatives ought to work from, and live in, their assigned regions. As "home folks" they would be more sensitive to particular regional problems. In addition, operating from within a region eliminates the time lag in getting to local districts from Eugene and reduces the expense of long distance travel.

COMMUNICATIONS

The breakup of the Bell telephone system will have significant impact upon our user districts. For several years OTIS has been one of the major users of leased telephone lines in the state of Oregon, with the majority of these lines being supplied or controlled by the Bell system. As telephone company customers are learning, the net result of the divestiture will be increased costs. For agencies such as OTIS, the increase will be of major proportion.

With these ramifications in mind, in June 1983, the OTIS Advisory Committee authorized the formation of a "Blue-Ribbon" Communications Advisory Committee. Its members include user district superintendents and knowledgeable lay people. The committee will study options and alternatives for upgrading our existing teleprocessing network and design a plan to ensure user districts more accessibility to their data. It will also review a variety of hardware and vendors and the actual means of communication. A realistic look will be taken at media options such as availability of satellites, microwave, coaxial cable, fiber optics, and other esoteric delivery systems.

The move to regional centers has the potential of reducing the impact of greatly increased communication costs. Nearly every terminal at every site now in user districts uses a leased line connected to OTIS in Eugene. Regional centers would significantly reduce the number of long distance lines to Eugene. Instead, by running shorter communication lines from various locations in user districts to their regional center, fewer lines will be needed from that center to OTIS. Management is confident that the basic network can be configured to incorporate mini-computers, micro-computers, and the remote printing needs of each location where processing or copy distribution is desired. The study should result in reduced future network costs because of divestiture by increasing line speed, number, and type of terminals which can be served over the same communication link.

The committee will consider the benefits and limitations of direct lines versus dial-up communication between the regions and OTIS Central. Comparative costs, capacity, reliability, accuracy, data updating, resource scheduling and sharing, location feasibility, and security will also be factors examined. The teleprocessing study, with recommendations, should be complete by the end of December, 1984.

RECOMMENDATION/TIMELINES/COST

Thus far, the regional concept and levels of service have been dealt with abstractly in this paper. At this juncture, however, specific recommendations will be made by OTIS management for each region.

OTIS Northeast Region: We believe the region served by a center located at Umatilla ESD including, in addition to the local districts in Umatilla County, all user districts in Hood River, Wasco, Morrow, Union, Baker, and Wallowa Counties, should be funded at a full-fledged Level "A" basis for 1984-85. At the present time that regional center is being funded at a cost of approximately $20,000 a year, which is less than Level "A" costs proposed in this paper. Level "A" should cost approximately $1,000 for paper and other supplies, about $38,000 one-time cost for hardware. In addition, there would be an expenditure of approximately $3,600 yearly for maintenance, and $1,500 annually for workstation software. The cost to OTIS for one-half the salary of a half-time field representative would be approximately $8,000 per year.

As their contribution to the success of the regional concept, OTIS management should negotiate to have Umatilla ESD provide the physical space and utility hookups needed for the regional center. In addition, the Umatilla ESD should provide, at no cost to OTIS, a cooperative program which would utilize the courier services to deliver OTIS reports of all ESDs which have local districts participating in the center. The cost for communication lines between the center and OTIS Central and between the center and local district users should be paid by the regional center. The salary for a full-time machine operator/distribution/control clerk and for one-half the salary of a half-time field representative would be paid by the center.

OTIS South Coast Region: For 1985-86 OTIS should negotiate with Coos ESD to serve users in Curry and Coos Counties at a start-up Level "A." OTIS should pay about $600 for paper and supplies and $20,000 one-time cost for hardware. OTIS should also employ and pay one-half the salary for a half-time field representative at approximately $8,000 per year. Coos ESD could provide a cooperative program with Curry ESD for courier service to deliver OTIS reports, and provide the physical space and utility hookups at no cost to OTIS. The center should pay for communication lines to OTIS Central and for lines from its local districts to the center, for the salary of a full-time machine operator/distribution/control clerk, and for one-half the salary of a half-time field representative. Annual maintenance costs would be about $3,000, paid by OTIS.

OTIS Mid-Oregon Region: In the center located in Administrative School District #1, Deschutes County, OTIS should begin to operate at advanced Level "A" in 1984-85. This region should serve all the local districts in Deschutes and Jefferson Counties and perhaps Klamath Falls School District #1 and Klamath Falls Union High School District #2 in Klamath County. The costs for paper and supplies would be paid by OTIS at $1,200 and hardware costs at $42,000. Maintenance costs would be about $3,600, and workstation software, $1,500 per year. One-half the salary of a half-time field representative would cost OTIS approximately $8,000 annually. Administrative School District #1 in Deschutes County, and other participants in the region should fund the costs for physical space and appropriate utilities as well as the costs for communication lines between the regional center and OTIS Central and between its local districts and the center. Personnel costs would include the salary of one full-time machine operator/distribution/control clerk and one-half the salary of the field representative. In addition, Administrative School District #1 should work cooperatively with Klamath County, Jefferson ESD, and Deschutes ESD to utilize their courier services at no cost to OTIS.

OTIS Northwest Region: In the northwest part of our state negotiations ought to be entered into with Washington ESD in cooperation with Beaverton School District 48J to develop a Level "B" center. To provide time for gaining experience, this center should serve only Washington County for most of 1984-85. The inclusion of users in Columbia, Clatsop, and Tillamook Counties could possibly be considered for the second part of 1984-85, and certainly for the 1985-86 fiscal year. In the recent past, Washington ESD has indicated their willingness to fund a higher level of service than offered by Level "A," the level OTIS management feels should be funded. Consequently, OTIS management should negotiate with Washington ESD to fund the difference between Level "A" and Level "B." Since they own a CPU, an equitable "use" fee for "hardware" should be agreed upon. Paper and other supplies at $1,000 and one-half the salary of one full-time field representative at approximately $16,000 should be funded by OTIS annually. As in the case of the other centers, physical space and utility hookups and courier services should be funded by Washington ESD. Staff costs for two full-time machine/operator/distribution/control people and one-half the salary of one full-time field representative and costs for communication lines between the center and OTIS Central and between the center and its local districts should be paid by the regional center.

OTIS Central Region: Because of their physical proximity to OTIS, Lane ESD and the local districts in Lane County will continue to be served from the OTIS Central location. As noted earlier, School District 4J in Eugene has a Remote Job Entry facility to serve their special application needs.

OTIS management recommends that Douglas ESD and the local districts in Douglas County, user districts in Lincoln County and, perhaps, Polk County also continue to be served from the OTIS Central region in Eugene until a decision is made as to whether this area should host its own regional center, be considered part of the South Coast Region, or continue the present arrangement.

Services provided for Lane, Douglas, Lincoln, and Polk Counties will continue on the current basis from the OTIS Central site when decentralization occurs. Therefore, there will be no charge for the additional services of a field representative working from a regional center as there will be for the other regions at that time.

ADMINISTRATIVE USES OF COMPUTERS
NORTH CLACKAMAS SCHOOL DISTRICT

Financial Services Programs

- E.S.D.

Personnel Services Programs

- Personnel Data
- OSHA Project

Support Services Programs

- Work Orders
- Energy Use
    - Gas
    - Oil
    - Water
    - Electricity
- New Construction
- Consumable Inventory
- Food Services
    - Inventory
    - Profit & Loss
- Media Catalog
- Data Base Mgt.System
- Transportation
    - Bus Routing
    - Vehicle Maint.
    - Gas & Oil
    - Bdry. Planning
- Inventory

Instruction Services Program

- Speakers Bureau (Work Experience)
- Career Info. Services
- Word Processing
- Programming
- C.C.C.
    - Oak Grove
    - Lewelling
    - Milwaukie Elem.
    - Clackamas
    - AIM - GED
- T.S.C.
    - Bilquist
    - Concord
- Micro Computers

Student Data Program

- Attendance
- Scheduling
- Grade Reporting
- Student Discipline File
- OSC Project
- Special Student Tracking
- Textbook Inventory

Management System Programs

- Word Processing
- Electric Mail
- Calendar
- Tickler File

Gerald Larer

PERIOD - BY - PERIOD ATTENDANCE AND MORE

Wanda Johnson

South Eugene High School in Eugene, Oregon, is one of the best in the nation. This was acknowledged in 1982-83 when it was selected as one of the top 144 Secondary Schools in the U.S.A. according to the Secondary School Recognition Program.

We have had a lot of "firsts", so it was not unusual that we had one of the first computerized attendance systems in the state. The system was designed for a student body of about 1,200, a closed campus and a six period day. It was more than adequate for three or four years. Then South Eugene became a 4-year high school. Suddenly our enrollment grew to 1800 and we had an open campus and a 7 period day. Couple this with a campus which is located near the University of Oregon and a student body who enjoyed a university oriented attendance policy and our system went berserk. We had as many as 500-600 students per day missing one or more periods; one attendance secretary and no accurate system of accounting. We also added a "0" period and a guide period to our schedule. How could we ever find an attendance system to accomodate our new student body and our new 9 period day.

After a good deal of research we purchased The School Attendance System (TSAS). This is a centralized, integrated computer system designed to keep and report period-by-period and daily attendance on a school-wide basis. TSAS is the product of The Educational Administration Data Systems, Inc., of Springfield, Illinois. It is a USCD PASCAL system which is run on an Apple IIe microcomputer. A Scan-Tron optical mark reader is used for quick data entry and a Corvus hard disk is used for speed and optimum storage capacity.

With TSAS the attendance staff at South Eugene High School has the computer power to:

- Print Scan-Tron rosters for all classes
- Optically scan/input teacher marked absences/tardies
- Flag classes for which attendance has not been recorded
- Update student absence records from the Apple keyboard
- Alter any student's schedule from the Apple keyboard
- Account for new or dropped students automatically
- Excuse entire classes/teams prior to leaving the site
- Print daily attendance status updates for teachers
- Print a student's attendance for an entire accounting period
- Implement and enforce stricter attendance policies aided by swiftly documented attendance information

We are presently using a Corvus Constellation II or a Networking Corvus which allows us to operate two Apple IIe microcomputers at all times with the option of adding more as our budget allows. This would place a computer on the desk of each counselor and/or administrator and would give access to total school-wide attendance information immediately.

With our newly found system for keeping accurate and up-to-date attendance information came the need to change student behavior in relationship to attendance. Thus Saturday School was born.

Saturday School

As an alternative to suspension from school for unexcused absences, students are given an opportunity to attend Saturday School. It is a supervised detention held from 8:00 a.m. - 12:00 p.m. on Saturday. Students will have an opportunity to make-up work that has been missed during unexcused absences (four unexcused periods = one Saturday School).

Parent conferences had been held and in the past, students have been suspended for chronic unexcused absences. Parents, students, administrators and teachers have not viewed suspension as an acceptable solution to the problem (suspension seems to become an extension of the offense and often becomes a vacation for the offender).

Another option to suspension is work detail. Work detail may include such assignments as cleaning lockers and picking up litter. Some patrons object to work detail. It has been questioned as a tool for punishment and it is burdensome to school personnel in terms of supervision. Suspension and work detail seem to be tools of punishment as opposed to the positive opportunity that Saturday School provides, the time to make up work missed because of truancy.

Saturday School requires parent involvement and can be a positive step toward helping students accept the responsibilities of attending school and to realize the consequences of breaking attendance rules.

"Can a student be required to attend Saturday School?" Section 336.010 of Oregon Laws Relating to Public Schools and Community Colleges reads"... no pupil shall be required to attend school on any legal school holiday or on any Saturday...". It is an optional alternative to suspension for violation of the South Eugene High School attendance policy only. The administration of South Eugene High School recommends that attendance at Saturday School is voluntary and is the result of the parent and the student requesting this arrangement in lieu of regular school suspension because of truancy. Failure to report to Saturday School will result in suspension from regular school attendance for the original offense. If the option to attend Saturday School is not exercised, then the attendance suspension will be invoked.

Saturday School Guidelines

When a student accumulates four unexcused single period absences during the term, he/she will be offered four hours of Saturday School in lieu of suspension.

Students must attend Saturday School on the Saturday immediately following said absences or they will be suspended on the Tuesday and Wednesday of the following week. Students have only two days to clear absences after they return to school.

Regular school rules are in effect. Students who are uncooperative, unprepared (do not bring work to do) and/or misbehave will be asked to leave the school grounds. Parents will be notified immediately by telephone and school officials will be notified the next school day.

Roll will be taken at 8:10 a.m. and the supervisor will attempt to call the parents of students who were assigned Saturday School and did not arrive. The supervisor keeps accurate attendance records and completes all reports on students in attendance and on those asked to leave. Students will not socialize, eat, drink, sleep or move about the room.

No student will be admitted after 8:10 a.m. Students arriving after 8:00 but before 8:10 will remain until 12:10 p.m. One fifteen minute break will be scheduled from 10:00 to 10:15.

Students who do not fulfill their obligation for Saturday School will not be allowed to participate in any extracurricular activities during the week of the suspension (Monday through Monday).

It is the obligation of the student to check the Saturday School list and to clear up any discrepencies of what is recorded in the attendance office. This must be completed by 1:00 p.m. on Thursday of each week.

Now we had a system for keeping accurate and up-to-date information on student attendance and a Saturday School program which provided consequences for students with unexcused absences. What remained was a need to communicate with parents. South Eugene's answer to this problem is the Telsol.

TELSOL

Telsol is a simple device which when loaded with the telephone numbers of students who did not attend school, will automatically, unattended, deliver a message to the student's home in the principal's voice during the evening hours. The message indicates they were not attending school, gives a corrective action desired and can record responses to inquiries. The system is voice activated and provides efficient use of the response tape. It stores unanswered calls for later use and will make three attempts for busies or no answers. The system is also effectively used for notifying parents or teachers of meetings, special programs, etc.

With the Telsol, the machine will make calls directly from the information taken from our attendance data. The computer software to connect Telsol to the attendance data is written by the same company from which the attendance system was purchased.

In addition to regular attendance information to be given to parents via the Telsol, a big plus will be to notify parents that their students need to go to Saturday School. This will facilitate the whole process involving Saturday School and parents will know immediately that their students have this obligation.

Interviews were done with parents concerning Saturday School and they were all concerned with knowing that their students had attendance problems as quickly as possible. They were also asked if they would mind receiving a computer call. They all agreed that it made no difference as long as they were called. In addition to the people interviewed, we also asked a random sample of 67 parents whom we called on attendance matters if they would object to receiving a computer call about their student's attendance. Sixty-five said it made no difference as long as they received a call. One person admitted that they were intimidated by machines but would prefer a machine call to no call. The other person did not want a computer call if the machine would take the job of a secretary. The lady wanted to be called regardless.

The Telsol has not replaced a secretary but simply allows us to communicate with parents who have not received calls before, because there was no one to make the calls.

CONCLUSION

It is exciting to see this project come together. In January 1984 South Eugene introduced the TSAS (school attendance system). Saturday School was the second phase in the attendance process and was designed to provide some consequences for students who were identified as having attendance problems. This program was implemented Fall term of 1984. Now the Telsol has helped us tie these components together and helped us communicate effectively with parents. It was implemented in March 1985.

Our future plans call for even greater computer power with the purchase of three more administrative programs from Educational Administrative Data Systems, as our budget allows. The three programs are the Registration and Scheduling System (TRSS), The Grade Keeping System (TGKS) and the EADS Data Base System (TEDBS).

These programs are designed to work together to provide a total student information processing system to meet the needs of our professional staff. All of these programs can be customized to our specifications and South Eugene can be independent of any outside system.

With the use of all three programs attendance at South Eugene High School has improved. We have cut the number of students who miss 1 or more periods per day by 200. This number has held consistently during the spring term.

The staff at South Eugene is very supportive of the three programs. The faculty council has voted to publicize all three programs in our first Parent Newsletter this fall. Also they have voted to include attendance as a top priority in each "Planned Course Statement" on file in our building.

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